SCIENTIFIC AMERICAN

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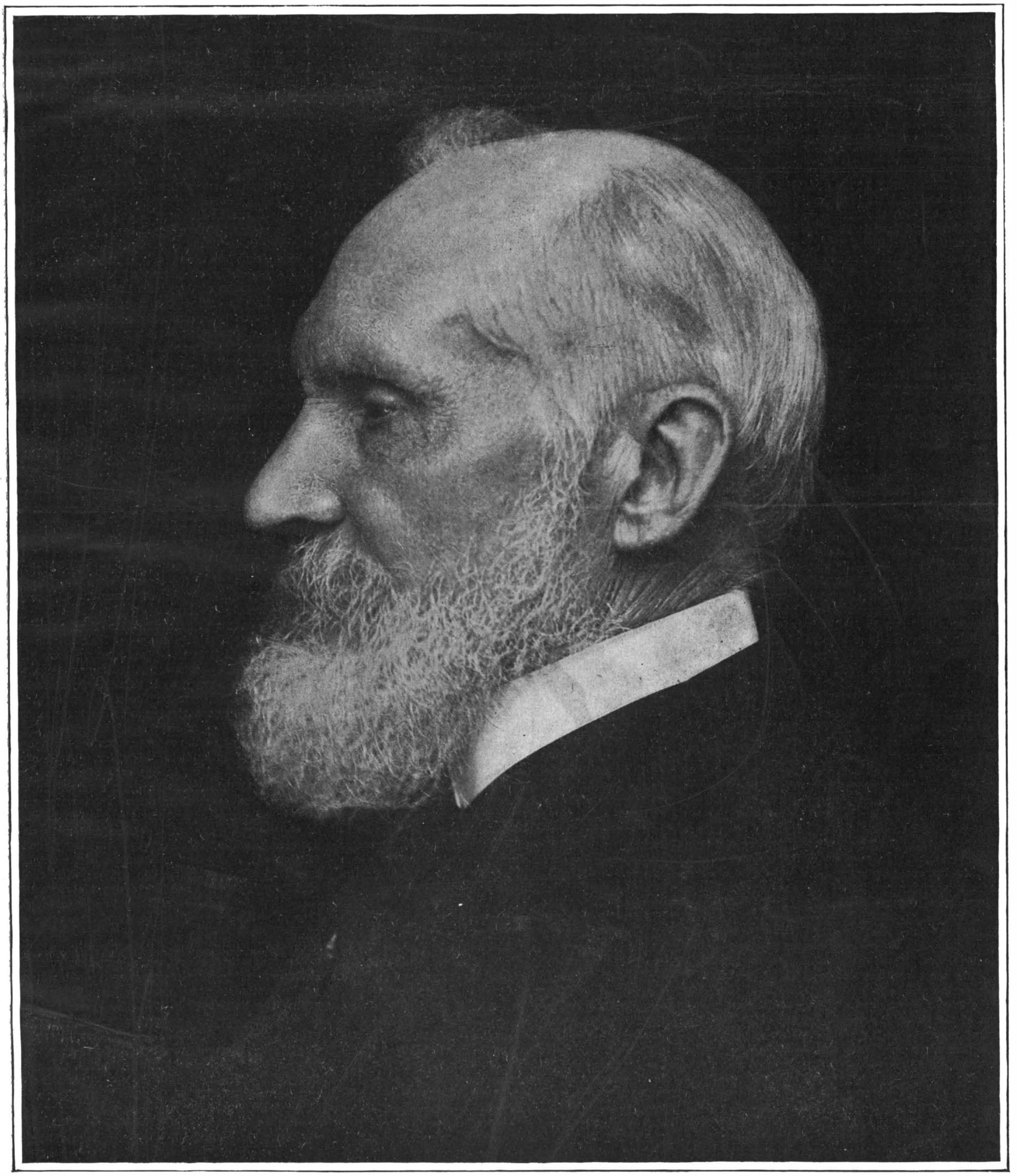

Photo. by Hollinger.

Kelvin

[See page 475.]

SCIENTIFIC AMERICAN

ESTABLISHED 1845

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NEW YORK, SATURDAY, DECEMBER 28, 1907.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

BUILD GATUN LOCKS FOR THE FUTURE.

Recent towing tank investigations carried on independently by both the British and the German builders of large and fast ocean steamers, have established the fact that in ships of the largest dimensions and high speed, a liberal amount of beam in proportion to length is conducive to speed. This accounts in part for the great beam, 88 feet, of the two latest Cunarders; moreover, a tentative design was drawn up recently in Germany for a vessel similar to these, in which the unprecedented beam of 90 feet was found to give the best results. There is no reason to suppose that a beam of 88 feet and a length of 790 mark the limit of size in future ocean steamers. On the contrary, the builder of the "Lusitania" recently assured the writer that, as the result of his observations, while crossing in that ship, he was more than ever convinced that there was every advantage of speed, safety, comfort, and economy to be derived from great size, always excepting, of course, the increased difficulty of handling at the terminal ports. The same authority stated that he confidently looked for ships to grow ultimately to a length of 1,000 feet, with other dimensions in proportion.

If this be so—and it is a prediction that has frequently been made by those who build and operate large ocean steamships—the statement should have a controlling influence in the deliberations which are now being had to determine what increase to make in the width of the Panama locks. Should the present proportions of beam to length be adopted in a 1,000-foot ship, she would have a beam of not less than 110 feet; and since draft will always be limited by the depth of channels, it is certain that in the future full advantage will be taken of the benefits conferred by great beam. This would indicate that, if we would build for the future, the Gatun locks should certainly be made not less than 115 feet in width. The 1,000-foot ship may not come for twenty-five years; although at the present rate of increase, it is quite conceivable that it may make its appearance before another decade has passed. Such great public works as the Panama canal should be built, as far as possible, for all time. The duties which we owe to posterity are little less imperative, at least in certain relations of life, than those which we owe to the present generation; and if by a moderate increase in cost we can spare posterity a great future expenditure, and, what is more important, an enormous amount of delay and congestion in the operation of this international waterway, it is clearly our duty to do so.

Nor is it to the point to affirm that the growth of future steamship dimensions will be confined to the Atlantic Ocean. There are abundant reasons to believe that the most striking development of the world's trade during the twentieth century will be witnessed in the Pacific Ocean, and will be due to the development of the Oriental peoples and the fabulously rich natural resources of the countries they inhabit. The ships that carry this trade will be of large capacity. The tendency of all construction is toward concentration, the building in units of ever-increasing dimensions; and though we may not see 25-knot passenger steamers making the trip from the Atlantic to the Pacific by the Panama canal, there is every probability that the intermediate type of freight-and-passenger steamer of large size and moderate speed, as the trade with the Pacific *via* the canal is developed, will grow to unprecedented proportions. An increase of the locks from 100 to 115 feet would, of course, add a considerable sum to their cost; but it would not involve any structural difficulties which could not be met by the provision of greater thickness and strength in the concrete walls and floor, and in the lock gates.

PROPOSED GOVERNMENT FOREST PRESERVES.

It will doubtless surprise the lumber interests of this country to learn from the Secretary of Agriculture, that during the last seven years, in spite of an unprecedented demand, the amount of hardwood timber which has been cut from our forests has fallen off over fifteen per cent, and this, furthermore, in spite of the fact that the wholesale prices of hardwood lumber have advanced from twenty-five to sixty-five per cent. Moreover, the amount of standing hardwood in this country is estimated to be sufficient to last for the next sixteen years only.

We are thus brought face to face with the fact, warning of which has frequently been given of late years, that we have been using up our natural timber resources with a prodigality which was certain to bring us, within a few years, to the verge of a timber famine.

The Bureau of Agriculture urges immediate action to prevent the complete wiping out of our timber resources. National forest reserves are to be formed by the purchase of 5,000,000 acres in the Southern Appalachians, and of 600,000 acres in the White Mountains. The report of the Bureau upon which this recommendation is based contains the first thorough analysis of conditions in the districts affected. It gives some striking statistics, also, regarding the amount of water power available, in which it is shown, not only how completely the nation depends upon the Southern Appalachians for its future hardwood supply, but also what a great reduction the continued removal of the forest would make both in the navigability of the streams which head in these mountains, and in their value for water-power purposes. Both the Northern and Southern mountain ranges affected are shown to be advancing rapidly toward a condition of barrenness. In the uplands to the south of Pennsylvania fully 100 square miles of arable and forest land are lost to the country every year by the denudation of the forests and the resulting washing away of the soil.

The Bureau brings out some startling facts regarding the water-power conditions, particularly in the Southern Appalachians, whose streams afford, during the lowest water of the year, a minimum of 2,740,000 horse-power. This could be developed by proper systems of storage from three to thirty times, and, on the supposition that one-half of the minimum horse-power would be available for industrial development, the Bureau states that the rental of these developed water powers would be worth $27,000,000 a year. If to this were added the possible revenue from the fifty per cent of power which is present for only one-half the year, the total rental would reach the high figure of $38,000,000. The question is one of the most urgent that will come before the present Congress; and whether the comprehensive and costly scheme as outlined by Secretary Wilson be adopted in its entirety or not, it is certain that some restrictive and preservative legislation should be immediately enacted.

ENORMOUS DEATH ROLL AMONG THE MINERS.

With the recent tragic mining disaster fresh in the public mind, there comes the official announcement from Secretary Garfield of the Interior Department that the number of these accidents, caused directly or indirectly by mine explosions, has been steadily increasing. In speaking of the causes and prevention of these disasters, their increase is attributed in part to the lack of proper and enforcible mine regulations; to ignorance of the explosives and the proper conditions of their use in the presence of gas and dust; and to the fact that not only is the number of miners increasing, but the coal is being taken from greater depths or farther from the entrance, in locations where ventilation becomes increasingly difficult, and the liability to accumulations of explosive gas more pronounced.

As usual in these investigations affecting the safety of life and limb, the fact is brought out that the loss of life is far greater in America than in Europe. There are killed annually in the coal mines of the United States three times as many men per thousand as there are in the coal mines of most European countries. During the last seventeen years, 22,840 men have lost their lives in our mines, and 11,000 of these deaths have occurred during the past six years. During the year 1906, no less than 6,861 men were killed or injured in the mines, 2,061 of these being killed outright, and the injured amounting to 4,800.

The terrible significance of these figures is enhanced when we learn from this government report that while the number of deaths per thousand has undergone in European countries a decided decrease, in this country it is steadily increasing. The improved conditions abroad are due to judicious mining legislation for the safeguarding of the lives of the workmen, and this legislation has been the outcome of the work of government testing stations, established to study the problems involved in the use of high explosives, and to devise means for rendering mining in general less precarious.

VIBRATION IN PASSENGER SHIPS.

Some surprise and disappointment has been expressed by passengers on turbine-propelled ships that vibration, although it has been greatly reduced, has not been entirely eliminated from these vessels. In considering this subject, it may be as well to state at once that, no matter what kind of engine be used, vibration never will be eliminated from steamships driven by screw propellers. The hull of a steamship is a highly elastic structure and, therefore, peculiarly sensitive to any forces tending to set up vibration. These forces may be broadly divided into three kinds—the impact of the waves; the unbalanced moving weights of the engines; and certain inequalities in the thrust of the propellers. Vibrations due to the shock of the waves may be disregarded as being too infrequent to cause any discomfort. It is only in heavy weather that they become of sufficient magnitude to attract the attention of the passengers, and even then it is only at long intervals that the sea will strike a blow sufficiently powerful to cause the whole ship to vibrate. The second cause, unbalanced or imperfectly balanced moving weights in the reciprocating engine, is, or rather was, the most annoying trouble, since it was responsible for that incessant pounding, and in some cases very violent vertical and lateral vibration, which was for many years the bane of a deep-sea passage. A few years ago, however, after a thorough investigation, Messrs. Schlick, Yarrow, and Tweedy devised a system of arranging the relative positions of the cranks and other moving parts of the engine which resulted in a great improvement; although in the latest high-powered transatlantic ships a considerable amount of engine vibration still remains, especially when the engines are racing. With the introduction of the steam turbine, however, vibration from the engine was absolutely eliminated, the moving parts being perfectly balanced and, therefore, incapable of producing those mechanical couples which, in the reciprocating engine, send a rhythmical series of tremors through the whole structure of the ship.

The public at large, on hearing that an absolutely vibrationless engine had been produced, jumped to the over-hasty conclusion that all vibration of the ship had at last been eliminated. In this they were not altogether to blame; for it must be admitted that the sponsors of the steam turbine, in speaking of its future benefit to marine navigation, had predicted an absence of vibration from the whole ship, which their knowledge of propeller action should have taught them was, in the very nature of things, impossible. The writer has stood in the engine room of the "Lusitania" at a time when there was perceptible vibration in the structure of the ship at a point some 200 feet farther forward, and failed to perceive the slightest sensible vibration of the engines, even when the hand was laid upon the casing of either the high-pressure or low-pressure turbines.

For the causes of such vibration, then, as occurs in a turbine-propelled ship one must look outside of the hull itself; and it is to be found, as we have already remarked, in the uneven action of the propellers, whose effect does not consist, as it theoretically should, in a constant axial pressure on the ship, but in a thrust which varies from a maximum to a minimum, and is in reality a series of rhythmical impulses. Theoretically, a three-bladed propeller, rotating at a certain rate of speed in undisturbed water, should exert a constant thrust. But, in the case of steamship propulsion, the propellers, so far from revolving in undisturbed water, exert their thrust upon water that is very much disturbed and flows past them in streams of varying velocity, full of eddies and more or less complicated motions. This movement is largely due to the friction of the water upon the sides of the ship. The layers of water in immediate contact with the hull tend to cling to it, and are dragged along with increasing velocity, until at the stern of a long ship they are traveling approximately at the same speed as the vessel. This drag on the water decreases with the distance from the hull, until undisturbed water is reached. Now, as a propeller rotates, its blades are alternately reacting upon dead water and water which is moving more or less swiftly forward against the thrust which the blades exert; and, consequently, the reaction against the blades is greater, or of a less yielding character, as they are passing through the water next the hull than when, on the other half of their rotation, they sweep through the still water fifteen or twenty feet away from the hull; in other words, each blade once in every revolution hits a hard spot, as it were, in the water, with the result that the impact sets up a series of tremors or vibrations throughout the whole structure of the ship, whose period will be equal to the number of blades in the propeller multiplied by its speed of rotation. Thus, in the case of the "Lusitania," whose three-bladed propellers make at full speed about three revolutions per second, one would expect to find, if this theory be correct, a frequency of vibration of about nine per second. Observations by recording instruments show that this is exactly what occurs. It is evi-

dent, then, from the above considerations, that although the steam turbine has entirely eliminated engine-room vibration, passengers on future high-speed boats must be prepared to submit to such limited discomfort as arises from vibrations which seem to be for the present entirely beyond human control. Evidently, if vibration is to be entirely eliminated, we must find some other means of propulsion than the propeller. There is one system which would bring about the desired result, namely, that of jet propulsion; but jet propulsion, in spite of the many ingenious efforts to develop it, has never proved a practical success, at least for high-speed vessels.

ANTHRACITE COAL CENTENNIAL.

Appropriate celebration of the centennial of anthracite coal is being considered by the citizens of the town of Plymouth, Pa. In 1807 the first shipment of the "black stone" was made by boat down the Susquehanna River, from Plymouth to Columbia, Pa. This date marks the beginning of the use of anthracite, which, according to records of the United States Geological Survey, was discovered about 1790, but was burned only by the use of blowers and forced draft before 1807.

It was the discovery that anthracite must be freed from every impurity and crushed to a uniform size before it could be successfully burned, which started the great industry that this year will probably have an output of 70,000,000 tons.

People had become accustomed to burning soft coal, which contained so much gas that lumps of any size could be readily ignited and burned without difficulty. Few would have predicted that, unlike soft coal, which is sent to market as it comes from the mine, hard coal would require preparation for market almost as complicated as the manufacture of flour from wheat.

The actual mining of anthracite is only the beginning of a long series of processes which produce the accurately sized pure coal which is so satisfactorily burned to-day in millions of homes and in heating plants of large buildings which must have smokeless chimneys. As it comes from the mines anthracite varies in size from lumps as large as a watermelon to those as small as a walnut. The large lumps are individually examined on benches, by men who are expert in detecting layers of black slate or other impurities which look much like coal and which are unavoidably mined with it. With small axes the lumps are cracked, and every vestige of unburnable material is removed before the coal is passed on to be crushed and sorted, by passing over moving screens, into the numerous sizes ready for loading on the cars.

Lumps too small to be separately inspected on the start, are crushed first and screened into uniform sizes, after which boys pick out all the impurities as the coal passes slowly in thin layers down long chutes. In some localities considerable dirt adheres to the coal, and in addition to the crushing and sizing it is necessary to subject it to several washings during preparation so that it will be clean and bright and all impurities can be readily seen and removed.

EDWARD LEAMINGTON NICHOLS.

BY MARCUS BENJAMIN, PH.D.

During the thirty years that have elapsed since the centennial year, but two physicists have been called to the presidency of the American Association for the Advancement of Science. In 1880 George F. Barker presided over the Boston meeting, and in 1889 Thomas C. Mendenhall was the presiding officer at the Toronto meeting. A year ago, in New York, when the selection of an officer to preside at the Chicago meeting next week was considered, the claims of the physicists were recognized, and Edward L. Nichols was chosen.

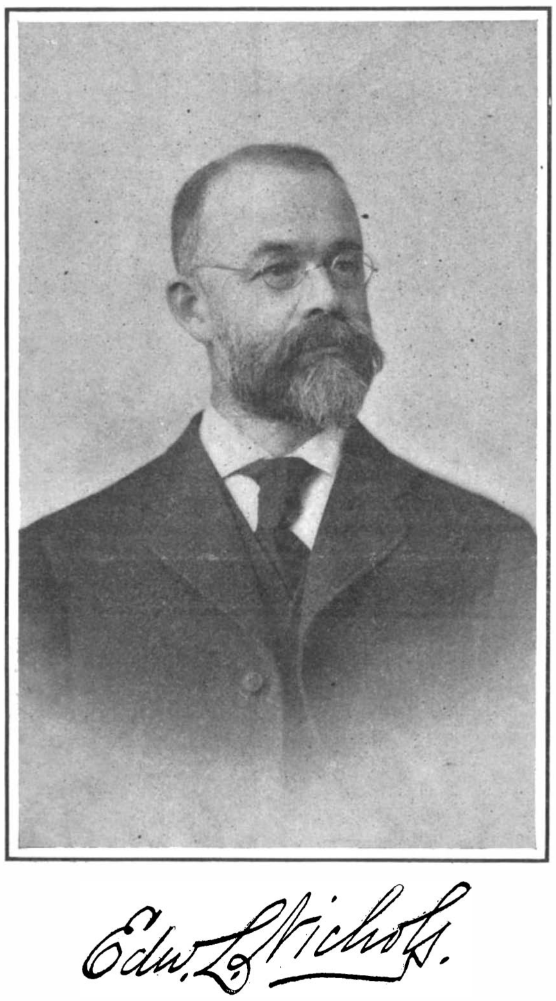
Edward Leamington Nichols is the son of the well-known landscape artist, Edward Willard Nichols, and was born in Leamington, England, on September 14, 1854, while his parents were on a visit to the British Isles. He was educated at Cornell, where in 1875 he took the degree of B.S., and then, choosing physics as his specialty, studied in Germany at Leipsic, Berlin, and Göttingen, receiving the degree of doctor of philosophy at the latter university in 1879.

On his return to the United States he had for a year a fellowship in the Johns Hopkins University, where he followed his chosen studies under Rowland, and then he served for a year as an assistant to Thomas A. Edison in his laboratory at Menlo Park, N. J. In the autumn of 1881 he began his professorial career by accepting a call to the chair of physics and chemistry in Central University in Kentucky, and two years later accepted the professorship of physics and astronomy in the University of Kansas. For four years he remained in that chair, and then returned to his alma mater in Ithaca, where he has since continued as professor of physics with a large corps of assistants under him.

Prof. Nichols has often addressed the meetings of the American Association, and he also deserves recognition for his contributions on science to popular magazines, and for his many valuable memoirs of contemporary scientists, among which particularly worthy of mention are those on Tyndall, Helmholtz, Rogers, and Bunsen. Of similar nature was his fascinating address on Franklin's researches in electricity, which he delivered at the bicentennial celebration of the birth of Franklin, held in Philadelphia in 1906 under the auspices of the American Philosophical Society. He then called attention to the fact that Franklin was "the author of the one theory of electricity which of all the views on this subject comes nearest to our twentieth century concept."

The honorary degree of LL.D. was conferred on him by the University of Pennsylvania in 1906, when he was characterized as "especially noted for his investigations on radiation and upon matter at low temperature. His researches have shed light upon the strange property of certain substances to become self-luminous by day or by night."

In the United States there are three societies to which one is chosen in consideration of high attainments in science, and to each of these Prof. Nichols has been elected. They are the American Philosophical Society, the American Academy of Arts and Sciences, and the National Academy of Sciences. He is also a member of the American Institute of Electrical Engineers, a past president of the Kansas Academy of Sciences, and the president for the year 1906-7 of the American Physical Society, of which he was



The New President of the American Association for the Advancement of Science.

one of the founders. The Sigma Xi, an honorary scientific society, also claims him as one of its founders, and he has been its president since 1904.

Prof. Nichols joined the American Association at its Saratoga meeting in 1879. Two years later he was advanced to the grade of fellow. His affiliations have been with the sections on physics and chemistry, chiefly however with the former, of which he was elected secretary in 1889, and vice-president in 1903. At the New York meeting in 1906 he was chosen president of the entire association. This recognition properly confirms his high rank among men of science in the United States, and establishes him as the foremost of contemporary workers in physics.

THE CURRENT SUPPLEMENT.

An interesting engineering achievement has recently been completed in India by spanning the river Indus with a double-deck steel cantilever bridge. The structure is described by the English correspondent of the Scientific American, and is also copiously illustrated. The improvements made in the materials used in building all kinds of machinery have, without doubt, been greater in the past few years than in any preceding period. E. F. Lake reviews the entire state of the art. Sir Oliver Lodge summarizes the present methods of tuning in wireless telegraphy. Some practical notes on etching are published. The attempts which have been made to produce synthetical camphor are reviewed. The geological formation of the Klondike is discussed by Dr. Willis Eugene Everette. B. M. Underhill contributes a splendid *résumé* of the evolution of the horse. The United States government has expressed its intention of using military balloons for the army. Accordingly the Signal Corps has drawn up some specifications for a dirigible airship. For the interest of inventors these are published in the current Supplement, No. 1669.

SCIENCE NOTES.

Experiments made by Prof. Frederic Bordas, of Paris, showed that quartz and flint were tinted rose color by the action of radium, that uncolored corundum was tinted bright yellow and that pale rubies had been brightened. The experiments showed that oxygen of the air was not affected by the action of radium.

A severe earthquake shock lasting six minutes was felt throughout the entire Japanese Empire from Hokkaido to the Bonin Islands. It occurred at 2.17 o'clock on the morning of November 22, and fortunately, no damage was done. Hokkaido and the Bonin Islands are respectively the most northerly and southerly islands of the Japanese archipelago. The earthquake area embraces over 1,000 miles of coast line.

The report of Prof. Philip Schneider, geologist at Syracuse University, who has been investigating the diamond fields of Pike County, has been filed with the State Commissioner of Arkansas. The report states that much of the inspected land is of no value, but that a few acres, making up what is called the Huddleston and Money places, comprises the most promising diamond land. Surface indications in this territory very nearly duplicate those in the Kimberley fields of South Africa, the earth resembling in every respect the soil of that region. Prof. Schneider says that genuine diamonds have without doubt been taken from the Huddleston tract.

The doctors of Vienna have organized an automobile club on a co-operative basis. It is proposed first to persuade the home manufacturers to build a car specially adapted for doctors' work. Then upon payment of a moderate sum down, followed by monthly installments, the club will assist the doctors to become automobile owners. The monthly payments will be less than the present cost of hiring a two-horse carriage by the month, as most of the doctors do. The club will have its own central garage, and branch garages will be opened in various districts of the city as the demand increases. The promoters of the association hope to increase the number of motoring doctors from the present twenty or so to at least 200.

In the side of an old well where it had lain undisturbed for 2,200 years, an earthenware jar containing five hundred pieces of the time of Alexander the Great has been found. One hundred of these were specimens of the silver tetradrachm of Alexander the Great, a coin corresponding in weight to our half dollar. The pieces are very thick and are made of silver of great purity. The obverse bears the head of Hercules in a lion's skin; the reverse shows Zeus seated in a chair. All bear the name of Alexander in Greek. Monograms and mint marks of great interest were found on many pieces of this lot, and some of the pieces bore the Greek word for the mint marks, designating the towns or cities where they were struck. The coins are all in very high relief, so that only two or three could be stacked together without their tumbling over. The find was made at Luxor.

THE FOREIGN AUTOMOBILE SHOW IN MADISON SQUARE GARDEN.

For the first time the importers of foreign automobiles will hold a show in Madison Square Garden, from December 28, 1907, to January 4, 1908. Some twenty different makes of foreign cars of all styles, together with their chassis, will be exhibited on the main floor, while the elevated platform around the arena and the galleries in the Garden will be given up to both foreign and domestic makers of accessories. Many of the exhibits which were shown at the Tenth Annual Salon in Paris have been imported for this show, and all automobilists who are interested in foreign cars, but who were unable to visit the Paris Show, will have an opportunity to see the latest and most approved types of high-priced cars.

TO OUR SUBSCRIBERS.

We are at the close of another year—the sixty-second of the Scientific American's life. Since the subscription of many a subscriber expires, it will not be amiss to call attention to the fact that the sending of the paper will be discontinued if the subscription be not renewed. In order to avoid any interruption in the receipt of the paper, subscriptions should be renewed before the publication of the first issue of the new year. To those who are not familiar with the Supplement, a word may not be out of place. The Supplement contains articles too long for insertion in the Scientific American, as well as translations from foreign periodicals, the information contained in which would otherwise be inaccessible. By taking the Scientific American and Supplement the subscriber receives the benefit of a reduction in the subscription price.

SAFETY SUIT OF AERONAUTS.

The accompanying illustration shows a padded suit and casque used by Count de la Vaulx in his recent balloon trips and aeroplane experiments. It was owing to the protection afforded by his padded helmet that the Count came out of his recent aeroplane accident without serious injury.

A CHEMICAL PUZZLE.

BY GUSTAVE MICHAUD, COSTA RICA STATE COLLEGE.

The following experiment is easily performed, even by those who have had little or no previous chemical training. It gives an idea of the infinite diversity of chemical and physical changes which one and the same reagent may induce in other substances.

Fourteen glasses, arranged in seven pairs, are brought before the spectators, who are requested to examine them and their contents. The experimenter then pours one and the same liquid into the fourteen glasses. The following contradictory results become at once apparent:

Substance contained in glass *A* becomes so hot that the glass cannot be kept in the hand. Substance contained in glass *A'* becomes so cold that frost promptly collects outside of the glass.

Liquid contained in glass *B* was blue; it becomes colorless. Liquid contained in glass *B'* was colorless; it becomes blue.

Glass *C* contained a clear liquid which becomes muddy. Glass *C'* contained a muddy liquid which becomes clear.

If a lighted match be introduced into glass *D*, several inches above the liquid, noisy flames are seen to spring in every direction. If the same experiment is made in the same manner with glass *D'*, the match is quietly but immediately extinguished. Liquid in glass *E* had a burning, suffocating smell; it becomes odorless. Liquid in glass *E'* was odorless; it acquires such an offensive smell that it becomes necessary to carry it outside.

Liquid in glass *F* was red; it becomes blue. Liquid in glass *F'* was blue; it becomes red.

Glass *G* contained a solid substance which becomes liquid. Glass *G'* contained a clear liquid which becomes instantaneously solid.

Every transformation is the result of the action of common hydrochloric acid over some chemical. Here is the nature and proportions of these; capacity of glasses being supposed to be about one pint.

Glass *A* contains 50 grammes of sodium hydrate dissolved in 100 cubic centimeters of water. This solution fills about one-half of the glass. During the experiment the other half must be entirely filled with hydrochloric acid. This should be poured slowly while the liquid is agitated with a glass or wooden stick. The last additions of acid cause the liquid to boil. The glass will then be found to contain common table salt mixed with an excess either of acid or of sodium hydrate. Glass *A'* is filled with sodium sulphate in small crystals, such as is sold by pharmacists to be taken internally. Enough hydrochloric acid must be poured to cover the salt. Temperature goes at once much below 32 deg. F. Cold becomes still more intense if the mixture be agitated.

Three-quarters of glass *B* are filled with water; then one decigramme of copper sulphate is dissolved in it. Ammonia is added in small portions until an intense blue color appears. The addition of hydrochloric acid will cause it to vanish. A solution of two centigrammes of potassium ferricyanide in 100 cubic centimeters of water is made in glass *B'* and, in this, another solution of 3 centigrammes of ferrous sulphate in 100 cubic centimeters of water is poured. A little ammonia is then added until the beautiful blue color vanishes. Hydrochloric acid will cause it to reappear instantaneously.

Glass *C* contains the ordinary solution of lead acetate sold by druggists for local or external application. Hydrochloric acid forms in it a dense precipitate of lead chloride. Three-quarters of glass *C'* are filled with water to which about a quarter of a teaspoonful of slaked lime, free from coarse particles, is added. Calcium chloride, resulting from the action of hydrochloric acid on lime, is exceedingly soluble in water.

A few pieces of zinc are deposited in glass *D*. Bubbles of hydrogen will set noisily on fire when a match is introduced into the glass. The experiment is free from danger so long as no attempt is made to close the glass.

One-third of glass *D'* is filled with wood ashes with enough water to make a thin paste. Carbon dioxide is the gas which promptly extinguishes the match. A hundred cubic centimeters of water, fifty cubic centimeters of ammonia, and enough litmus solution to

From the Sketch.

PADDED SUIT AND CASQUE FOR AERONAUTS.

give the liquid a bluish tint are poured into glass *E*. During the experiment, hydrochloric acid is added, little by little, until the bluish color suddenly becomes reddish. The odor will then be found to have vanished.

One-third of glass *E'* is filled with water, and 8 grammes of powdered iron sulphide are thrown into it. Hydrochloric acid will generate hydrogen sulphide in the glass. This gas is the active agent found in some mineral waters, to which it gives a characteristic smell of putrefied eggs. It is poisonous, but the

A CHEMICAL PUZZLE.

amount evolved during the experiment is small, and the smell is so strong that it makes the air apparently irrespirable long before there is any danger. It should not, however, be smelled directly over the glass, nor should the glass remain in the room longer than is necessary to detect the odor.

Glass *F* contains the same liquid as used in glass *B*, with the addition of one centigramme of aniline red scarlet. Glass *F'* contains the ordinary solution of blue litmus.

Calcined magnesia is the solid substance which fills about one-third of glass *G*, and the ordinary syrupy soluble glass or sodium silicate solution sold by druggists is the liquid substance which will become instantaneously solid, in glass *G'*, if mixed with about one-third its volume of hydrochloric acid.

AN INSTRUMENT FOR DRAWING ELLIPSES AND HYPERBOLAS.

BY HARRY A. HANNUM.

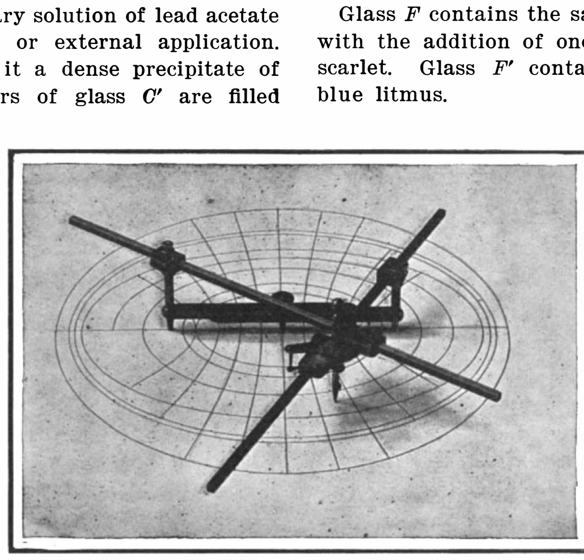
An ingenious instrument for drawing ellipses and hyperbolas has recently been invented which is so arranged that if a pen be used it will keep the latter at all times tangent to the curve. The instrument is based on the principle that the sum or the difference respectively of the distances from any point of an ellipse or a hyperbola to the foci of such curve is constant.

It is constructed with two posts provided with points to be placed at the foci of the ellipse or hyperbola. These two posts are connected by slotted beams clamped together by a thumb screw. On the top of each post is a stationary pinion, about which is swiveled a head. Passing freely through the two heads, and engaging each pinion are two racks, crossing each other and both engaging a traveling pinion. Passing through the traveling pinion is a vertical shaft, at the bottom of which is connected a pen or pencil. Around the pinion are two heads adapted to travel along the racks.

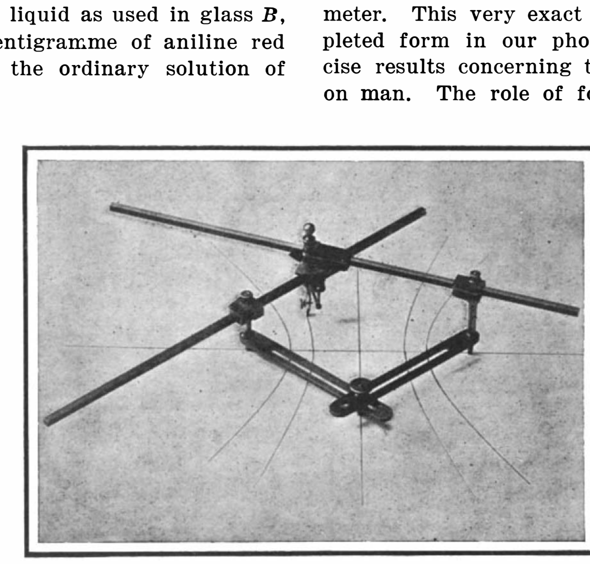
If the instrument is put in motion by placing the hand at the top of the shaft, the traveling pinion will revolve, taking up on one rack and letting out exactly the same distance on the other rack, thereby causing the pen to describe an ellipse which is mathematically correct. By reassembling the instrument so that the traveling pinion will pass between the two foci, the pen or pencil will describe a hyperbola. For drawing an ellipse with ink, it is necessary that the pen always travel tangent to the point of the curve which it is drawing.

The mechanism which achieves this purpose is based on the well-known property of the ellipse or hyberbola, that the tangent in each point of the curve bisects the angle between the two connecting lines of said point with the foci of said ellipse. Each of the traveling heads is provided with a flange, in which is cut a spiral-shaped groove running in opposite directions. Between the two flanges there is a steel plate swiveled around the pinion and having a slot running in a radial direction. The pin engaging both of these grooves, and also a slot in the plate between the two flanges, causes this plate to revolve around the vertical shaft whenever the instrument is put in motion. The steel plate has an extension at the point opposite the radial slot, in the end of which is riveted a short vertical pin engaging a hole at the end of a horizontal arm, which is threaded into the head carrying the pen. By this arrangement the revolving motion of the steel plate is conveyed to the pen, and thereby the pen is properly directed.

By using an attachment not shown in the cut to take the place of one of the posts at the foci, and having this slide along a T square, the pen or pencil will describe a parabola.



The Instrument Arranged for Drawing an Ellipse.



Arrangement for Drawing a Hyperbola.

AN INSTRUMENT FOR DRAWING ELLIPSES AND HYPERBOLAS.

THE NEW HENRY DYNAMOMETER.

BY JACQUES BOYER.

Mr. Charles Henry, director of the laboratory for investigating the physiology of the sensations at the Sorbonne, has just designed a new registering dynamometer which allows the energy of the muscles of the hand to be measured, at the same time eliminating the effect of pain, that prevents the exertion of the full strength in the various types of spring dynamometer. This very exact apparatus, shown in its completed form in our photographs, will give very precise results concerning the influence of various diets on man. The role of foods is twofold: They should furnish the material for the growth or repair of the tissues, and at the same time should make up the expenditures of energy of the organism, whether these expenditures are in the form of heat or in the form of mechanical work. Certain foods, like the albumens and the fats, contribute both to the repair of the tissues and to the production of energy. Others, such as the hydrocarbons, seem to serve entirely as energy furnishers. But within what limits

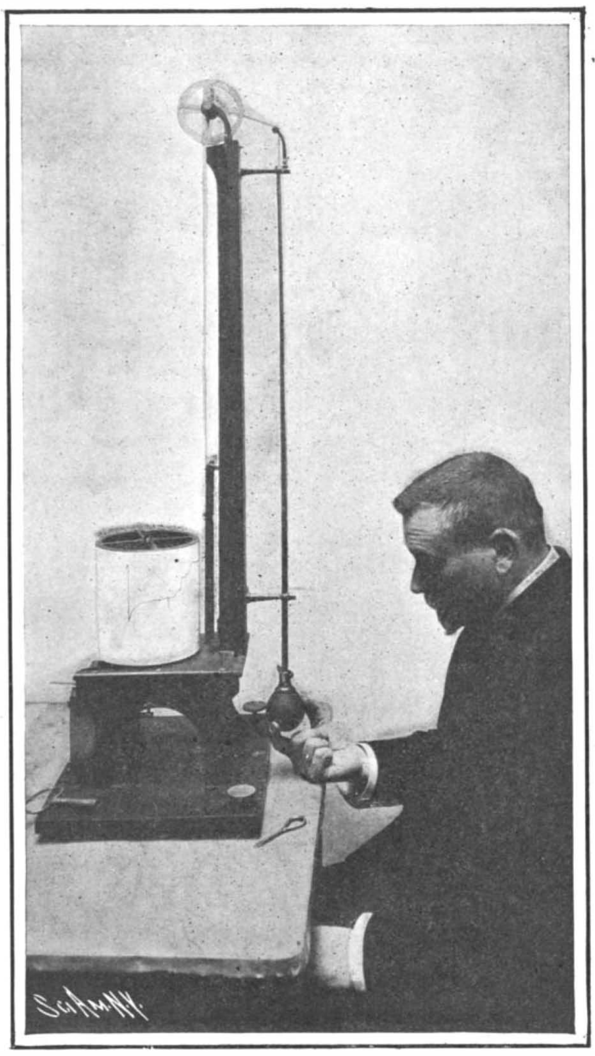
does each one of these classes of products attain one or the other ends of rational alimentation? The only way to answer this question is by determinations of the energy expended combined with chemical researches. Unhappily, exact apparatus for measuring the applicable energy of a muscular system has been lacking up to the present. Springs of elliptical form, which serve in physiology as dynamometers, are more or less inexact measurers of exertion, because the pressures exerted by the fingers on the different parts of the ellipse oppose each other, and this force of deformation is not registered by the needle. Moreover, these dynamometers do not indicate the duration of the pressure, an essential thing to know, because men of relatively feeble strength but with rapid muscular co-ordination can produce, all things being equal, higher pressures than other men who are relatively stronger, but who are slower.

A muscle is not tired out when it has reached its maximum pressure, since it maintains this pressure a certain time, and does not give way until the end of a short interval. This makes it necessary to record variable and decreasing pressures.

Verdin has indeed transformed into dynamographs the dynamometers of Duchene de Boulogne, applying to them a system of air transmission by means of Marey drums, which, by the play of a lever, register pressures on turning cylinders. These dynamographs constituted an important theoretical progress over the old dynamometers, but the metallic springs of various forms that they utilized had also the double disadvantage of only responding to the normal pressures of the steel blade, and utterly ignoring the lateral pressures. They indicated at each instant but a small stress, because of the pain caused by the rigidity of the metal. For example, the fatigue curves obtained with the dynamometer of Mr. Charles Henry present a normal form very different from those furnished by spring dynamographs.

The new apparatus consists of a spherical bulb of rubber ending in a shoulder, that permits it to be joined to a metallic tube in such a way as to allow only the spherical portion of the envelope to be deformable. This bulb is full of mercury, which under the pressure of the hand or of the fingers, mounts to different levels in the metallic tube. A mass of iron which is raised by the mercury communicates its movement through a thread rolled around a convenient reduction pulley (1-6) to a pen, which traces the pressures on the recording cylinder.

This cylinder is covered with paper squared in millimeters, and is made to move by clockwork, which gives it the uniform velocity of one millimeter a second. Upon pressing the bulb, the subject obtains at each instant the maximum pressure, until he is exhausted. With the system of Mr. Henry there is no deformation of the tracings, and since the transmitting device is inalterable, the curves are always comparable. Moreover, the double graduation fixed on the card indicates the total pressure and the work done. The area of each of the recorded curves measures what is called the "static work," or in other words, the product of the mean pressure and the duration of the effort of the flexor muscles of the fingers. Now, Mr. Henry and Miss Joteyko have shown experimentally that to be able to calculate in kilogrammemeters the work performed by the same expenditure of energy, that is to say, the available energy of the muscles, the number of kilogramme seconds represented by the static area must be divided by 120. Thanks to his dynamometer, the inventor obtained in the course of several experiments measures of static work varying between 99 and 490, the available energy corresponding being between 0.8 and 4. The mean ratio of "static work" to maximum pressure equaled 3.3, while according to the spring dynamographs of Charles Verdin the same ratio was 66.3, or twenty times greater. Moreover, the fatigue curves obtained with the new apparatus show notable differences from those furnished by the older forms. At first, the decrease is much slower; then at the end a more rapid decrease of the exertion with the time is indicated. This proves that the spring dynamographs should be given up, since the factor of pain keeps the subject from giving at each moment his maximum pressure. The muscle reposes to an unknown degree, and the static areas formerly calculated lack exact significance.—Translated from the French of Jacques Boyer for the Scientific American.



THE NEW HENRY DYNAMOMETER.

THE OVAL BILLIARD TABLE.

An innovation in the game of billiards has recently been introduced in England in the form of a table in which the familiar rectangular shape is superseded by an oval. This development is the outcome of modern exigencies, more especially owing to the perfection of certain strokes, such as the "Anchor," which, once the position has been secured, enables the player to continue scoring indefinitely. Such nursing of a certain position has rather depreciated interest in the game, and the scientific evolution of new strokes, and the study of angles resulting in what is known in the billiard parlance as top-of-the-table play, has rendered the game somewhat monotonous to follow when two skilled manipulators are pitted against one another. In order to obviate such unvarying repetition, the present table has been evolved, as thereby a more open game is assured. Though popularly described as "oval," the shape is in reality "arc-oval," its form being clearly demonstrated in the accompanying diagram. It is constructed by the arcs of two circles of fixed relative sizes, which approach the figure of an ellipse. This method of construction is essential in eliminating the difficulty in finding the angle vertex on the ever-changing curve of the oval or ellipse.

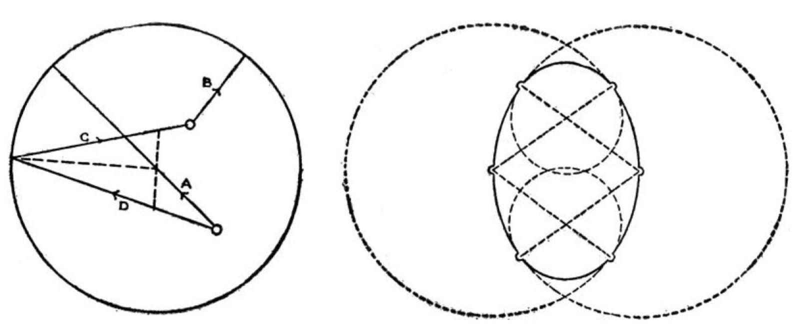
This design has been worked out by Mr. J. J. Pearson, an English architect, and he was influenced in his experiments by the fact that among the many recognized geometrical figures, none approaches in versatility of angle problems those of a curved formation.

The possibilities of play upon a circular table, which it may be explained also serve as a key to all play on the arc-oval table, may be gathered from the second diagram. Here a ball struck from, or in line with, the center returns direct, or if played to pass the center at a given distance, returns the same distance on the other side. It will thus be realized that the dividing line of any angle springs from a definite point on the table, in variance to that obtaining on the oblong table, where it is ever at a right angle to the cushion. The table, being inclosed by the arcs of four circles, has four central points.

In this table it will be seen that it is bounded by the arcs of four circles, the arcs of the larger circles forming the longer sides, while the arcs of the small circles constitute the short sides, the pockets of the same number as prevailing in the oblong shape and placed equidistantly. At first sight such a design might appear to present difficulties to the player, but in reality the game is considerably simplified, once the geometry of the angles and the properties of the circle are mastered. Easier and improved facilities for scoring are provided, since the cushion "fields" and the pockets "invite." The possibilities of the various angles thus placed at the player's disposal are illimitable. The play is considerably opened, and rendered more fascinating, while at the same time the difficulties of the divided ball are curtailed. There are many strokes only obtainable in one way on the oblong table, which are possible in several upon this latest design, while at the same time playing for safety is impracticable, and repeat strokes are reduced to a minimum.

At the same time, according to the experience of those who have tried their skill upon the new table, the balls are always more accessible, the rest is seldom needed, and one does not have to assume difficult attitudes to make a stroke. It is somewhat difficult for the player fresh from the old pattern of table to comprehend the behavior of the balls, which instead of making the designed rebound, often follow a whizzing course round the contour of the cushion at great velocity, and will pass the opponent's ball, which is only standing away from the cushion the distance of its own diameter.

Those familiar with play on the oblong table, and who have tested the arc-oval design, concede that the latter gives a more scientific basis to the game, and provides far greater possibilities for the exhibition of skill, calculation, delicacy of touch, and execution of stroke. For the equipment of the private house it possesses distinct advantages, and owing to the absence of the awkward right-angular corner, lends itself particularly to the encouragement of billiard play by ladies. Certainly in England its inception is being appreciated, and it is being popularly received.



The Possibilities of Play on the Oval Table.

The Billiard Table Without Straight Lines is Intended to Prevent "Nursing" and "Top-of-the-Table" Play.

THE OVAL BILLIARD TABLE.

The destruction of lead or wrought-iron pipes by electrolysis has long engaged the attention of electricians, and expedients have been suggested to prevent it. These efforts have usually been directed toward preventing leakage of return currents, but a material has now been put on the market to insulate the pipes themselves. This is a covering of a specially-prepared asbestos paper in laminated form, thoroughly impregnated, and coated with a waterproof insulating compound. It acts as an insulating medium between the pipe and the ground, and being made of indestructible materials, is permanently durable. The covering is from ¼ to ⅜ inch thick and is made in 3 foot sections, to fit various sizes of pipes. All joints are sealed by strips and insulating cement, which are furnished with the covering. For sleeve couplings, etc., special sleeves are provided.

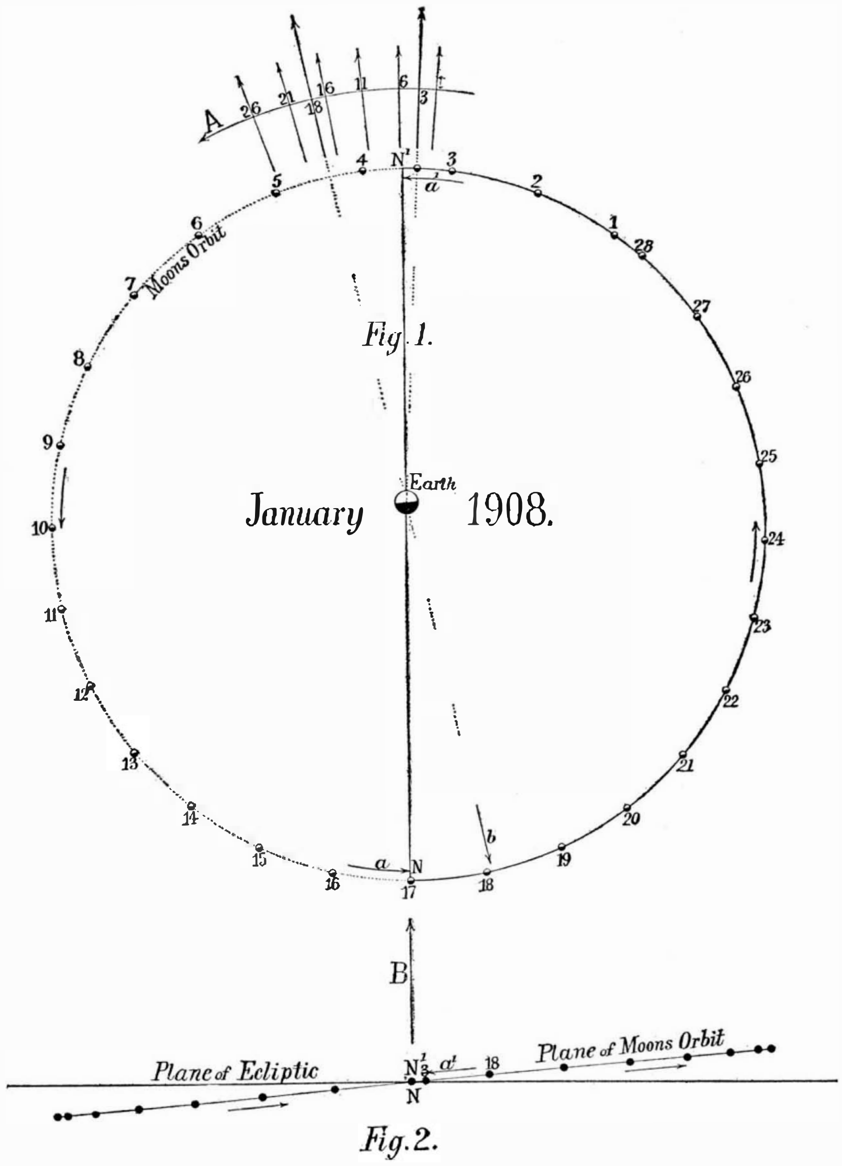
THE TOTAL ECLIPSE OF THE SUN IN JANUARY, 1908.

BY FREDERIC R. HONEY, TRINITY COLLEGE.

Eclipse seasons occur, on the average, at intervals of a little less than six months. The gradual advance of the dates of eclipses is due to a slow twisting of the plane of the moon's orbit in a direction contrary to that of her motion, which brings the line of nodes into a line joining the earth with the sun at an earlier date each year. The law governing this motion, and the dates of eclipses of the sun and moon for twenty years, were shown in an article by the writer in the Scientific American for May 25, 1907.

When an eclipse season occurs near the beginning of the year, there may be three eclipse seasons in that year. The year 1908 will be an example of this kind. The eclipses will be as follows: January 3, a total eclipse of the sun; June 28, an annular eclipse of the sun; December 7, a lunar appulse; December 22, a central eclipse of the sun.

Fig. 1 is a plot of the moon's orbit for January, 1908. The position of the moon is shown for each day of the month at Greenwich noon. If this page is placed in a horizontal position, it may be regarded as the plane of the ecliptic. The part of the orbit shown by the full line is above that plane, and that part represented by the dotted line is below. An edge view of these planes, looking in the direction of the arrow *B*, is shown by the intersecting lines. (Fig. 2.) The line of intersection of these planes, which is the line of nodes represented by the point *N* in Fig. 2, is the line *N N'* in Fig. 1. The direction of the moon's motion is indicated in both figures by the arrows. In Fig. 1 the arrow *a* indicates the approach to the ascending node *N*, where the moon passes from the space below to that above the plane of the ecliptic. The arrow *a'* shows the approach to the descending node *N'*. The direction of the *apparent* revolution of the sun around the earth is indicated by the arrow *A*. The positions of the sun and moon are here shown by their longitudes; the former at intervals of five days, and also on the 3d and 18th, the dates of new and full moon. The arrows radiating from the earth indicate the direction in which the sun is seen at the dates attached.

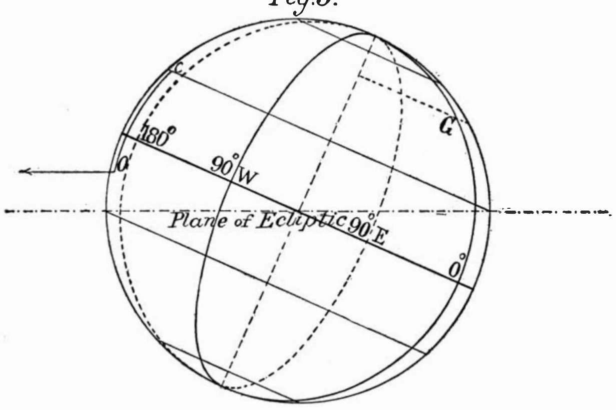


The Moon's Orbit for January, 1908.

The conditions necessary to an eclipse of the sun or moon are as follows: The moon must be at or very near one of the nodes at the time of new or full moon. The position of the moon, when the eclipse of the sun will occur on January 3, is shown between the positions marked 3 and 4, when the sun and moon will have the same longitude. The actual time of the eclipse is January 3, 9h. 45m.; the day beginning at Greenwich noon. The moon will be approaching the descending node *N'*, and her center will be very near the plane of the ecliptic. (Fig. 2.) The moon will also be very near perigee, which she will reach on the 4th, at which time she subtends a maximum angle. Notwithstanding the fact that the earth will be very near perihelion, when the apparent diameter of the sun reaches a maximum, the moon will subtend the larger angle; and along a narrow path on the earth's surface, there will be a total eclipse of the sun.

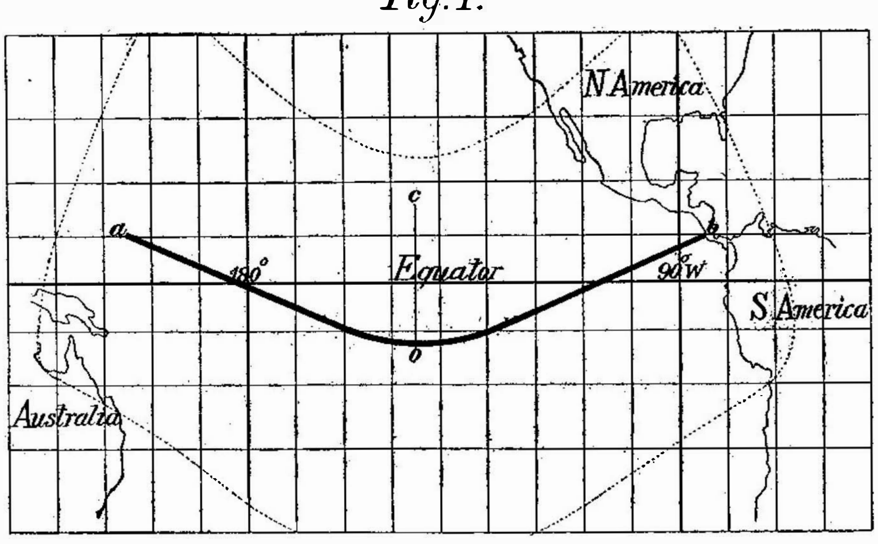
In Fig. 3 the earth is projected on a plane parallel to its axis, and perpendicular to the ecliptic. The point *O*, which is on the meridian, a portion of which is represented by the line *c O*, gives the position of an observer to whom the central eclipse will be visible at noon. This point will be nearly 12 deg. south of the equator. A line extending from this point to the moon's center, and produced to the sun's center, will form a very small angle with the plane of the ecliptic, because the moon's distance from the earth is about sixty times the earth's radius, and the sun's distance is nearly four hundred times that of the moon. In the figure the line of vision (in the direction of the arrow) is therefore very nearly parallel to the plane of the ecliptic. The path along which the total eclipse may be observed is shown by the heavy line *a O b*, which crosses the equator twice. (Fig. 4.) In this illustration the portion of the earth's surface from which the eclipse will be visible is limited by the dotted line, and is represented in Mercator projection. Beyond the limits of the path of totality, which is wholly in midocean, this eclipse is only partial, and within a limited land area. An eclipse season may include two or even three eclipses. Two weeks after the occurrence of a solar eclipse, an eclipse of the moon may be looked for. During this interval of time, the moon moves through half her orbit, from the position of new to that of full moon. In the latter position, if the moon is sufficiently near to a node, she will come within the earth's shadow. But in January, 1908, the date of full moon is the 18th, and the moon is at the ascending node on the 17th. (Fig. 1.) In the drawing, the sun, the earth, and the moon will not be in the same straight line until the 18th. The arrow *b* shows the direction of the line from the sun to the earth produced, indicating that the position of the full moon will be a short distance beyond that given in the plot; the actual time of full moon being 18d. 1h. 37m., when the moon is too far above the plane of the ecliptic to come within the shadow of the earth. (Fig. 3.)

Fig3.



The Moon is Too Far Above the Plane of the Ecliptic to Come Within the Shadow of the Earth.

Fig. 4.



The Path of the Total Eclipse.

THE TOTAL ECLIPSE OF THE SUN IN JANUARY, 1908.

How to Protect Our Eyes Against Ultra-violet Rays.

In an interesting lecture delivered before the recent Congress of German Naturalists and Physicists, Dr. Schanz and Dr. Stockhausen discussed the action of ultra-violet rays on the eye. Dr. Stockhausen, while working on electric arcs, had been attacked by a severe "electric" opthalmia caused by the ultra-violet rays of this source of light. Such rays, while invisible to the human eye, are readily detected by means of photography. A glass plate inserted between the eye and the illuminant had so far been considered a sufficient safeguard, but Dr. Stockhausen, though protected by eyeglasses, was made seriously ill.

The two authors therefore undertook an investigation as to how far glasses will absorb ultra-violet rays; only those of very short wave length, shorter than 300 $\mu\mu$, were found to be absorbed by ordinary lamp and spectacle glasses. Now, the rays most readily absorbed will penetrate into the human organism to the smallest depth only. The most efficient, and accordingly most dangerous ultra-violet rays are those intermediary between 300 and 400 $\mu\mu$ which traverse ordinary lamp and spectacle glasses. Ordinary protective spectacles will allow the blue ultra-violet rays to pass with ease. Smoke-gray spectacles, while reducing the intensity of the rays, as they do those of the visible spectrum, will not extinguish them entirely. Further experiments were made on the percentage of ultra-violet rays in artificial illuminants, decomposing their light by the aid of Watt's spectrographs. The results of those investigations, extending from pine torches and Roman oil lamps to the most recent electric lamps, show the percentage of ultra-violet rays to have increased greatly with the increasing intensity and temperature of our artificial illuminants. No attempt has so far been made to keep away from the eyes those rays, which, being invisible, are of no aid in the act of seeing. Common experience shows that when a given amount of work can just be performed without any appreciable fatigue of the eyes in natural daylight, the eyes will become tired much more rapidly by performing the same amount of work in artificial light. This phenomenon, which is especially noticeable in the case of catarrhal affections of the eye, proves that sunlight is not very rich in invisible rays, the latter being absorbed rapidly by our atmosphere, while a considerable portion of them is lost by multiple reflection before getting to our eyes.

In the eye itself, the lens will protect the retina against the effects of ultra-violet rays. By submitting the lens to the action of these rays, a strong fluorescence is obtained, showing the conversion of the invisible into visible rays. Now the question arises whether or not in the course of time this conversion of energy will result in appreciable alterations of the transforming organ. Some experimenters have indeed observed an alteration of the lens when subjected to an intense ultra-violet radiation, and it is suggested that the cataract observed in old age is due to such a cause. The authors finally point out the desirability of designing efficient safeguards against the action of ultra-violet rays, which are the more imperative, as apart from the possibility of accelerating the occurrence of old-age cataract, these rays doubtless irritate the front part of the eye. They further mention a special glass made by themselves for absorbing ultra-violet rays at a higher rate than is done by ordinary glasses.

According to a contemporary, a brick which contains 60 per cent or more of silica expands on heating, but a brick containing 53 per cent or less of silica contracts at temperatures above 3,000 deg. F. On this account, if a high silica brick is used in lining a cupola, there should be a layer of sand between the shell and the brick in order to make an elastic lining.

LORD KELVIN.

With the death of Lord Kelvin on the 17th of December, in the 84th year of his life, there was ended a career full of usefulness to mankind. To wonderful scientific attainments he united a faculty of practical achievement that placed him in the first rank of those who were pushing back the boundaries of the unknown. In his work the creative imagination played a remarkable part, but ever ruled and guided by rare mathematical perception and insight. Although his discoveries were perhaps not so sensational or so startling to the layman, they were fraught with a scientific worth that only his colleagues could fully appreciate. His work often blazed the trail, making the way for those who were to follow, as well as providing them with the means of pressing on to a more distant goal than was ever before reached. Nor did he lack the companionable qualities that are so falsely thought to be destroyed by a too close devotion to science, but kept up his interest in happenings outside of his chosen sphere. No better summing up of his life can be given than that of Thomas A. Edison, a friend of thirty-five years' standing:

"Lord Kelvin certainly had the master mind in science, for the world seldom sees such a man as he was. First of all he was great as a mathematician, and then he developed into the greatest of scientists. He was also of a practical turn, and the application he made of his researches enabled the human race to make rapid strides. I think it is safe to say that he gave more attention to such subjects as the power of the tides and the properties of the crust of the earth than any other scientist.

"With his great ability as a mathematician, he compiled the results of his numerous experiments and gave to us many of the fundamental laws of science, which we are putting to practical test in our everyday lives."

William Thomson, first Baron Kelvin, was born in Belfast on the 26th of June, 1824. His father, James Thomson, was professor of mathematics at Glasgow University, from which seat of learning he held the degree of LL.D. The younger Thomson always had taste for science, in fact, his scientific education commenced at the age of ten, for in 1834 he was a matriculated student of the University in which his father was professor. From Glasgow he went to St. Peter's College, Cambridge, better known as "Peterhouse," where he was graduated in 1845 as Second Wrangler; he was also first "Smith's Prizeman."

In 1846 he was made a fellow of St. Peters and professor of natural philosophy at Glasgow, serving in the first capacity until 1852, and in the second for a space of over fifty years. He was again made a fellow of St. Peters in 1872.

During the period of the laying of the various transoceanic cables, Thomson was called upon to lend his assistance, enjoying, as he did, even at that time, the reputation of England's greatest electrician. From 1857 to 1858, and from 1865 to 1866, he acted as electrician of the Atlantic cables, inventing in this capacity the mirror galvanometer and the siphon recorder.

His achievements in connection with the Atlantic cable gave him a worldwide reputation, so that many other cable services next claimed his attention, notably the French Atlantic in 1869, the Brazilian and River Plate in 1873, the West Indian in 1875, and the Mackay-Bennett Atlantic in 1879.

When the utilization of the water power of Niagara for manufacturing purposes was first discussed, Sir William Thomson was made chairman of the advisory board that had the matter in charge. His views on this subject, while in more or less direct opposition to American public opinion, are quite characteristic of the man. In 1902, at a reception at Columbia University, he spoke as follows: "Beautiful as is that wonderful work of nature, it would be more beautiful still if those waters fell upon turbine wheels, every one of which was turning the wheels of industry."

Five visits in all were made to America by the scientist, two of a purely professional nature, connected with the laying of the cables, in 1865 and 1866, and three others—in 1884, in which year he delivered the Baltimore Lectures at Johns Hopkins, in 1897 and in 1902. During the last trip, he visited a number of our universities, from several of which he received degrees, among them that of LL.D. from Yale.

The honors showered upon Lord Kelvin bear witness to the appreciation of his work. In 1866, on the successful completion of the Atlantic cable, he was knighted by Queen Victoria, and received the freedom of the city of Glasgow. In 1892 he was made a baron, because of his services to mankind, although it is rumored that the nature of his politics may have assisted in the matter.

In the year 1896, a jubilee was held in honor of his having occupied the chair of natural philosophy at Glasgow University for fifty years. Upon this occasion, the universities of Dublin, Cambridge, and Edinburgh each conferred upon him the degree of LL.D., while Oxford made him a D.C.L.

He was a fellow of both the London and the Edinburgh Royal Societies, receiving from the former the Royal medal, and from the latter the Keith prize. At one time or another he held the presidency of nearly every important learned society in England; of the mathematical and physical section of the British Association he has been the head five times.

From abroad he received a great number of decorations. He was a grand officer of the Legion of Honor, a commander of the Order of Leopold, and a possessor of the Prussian Order pour le Mérite, and of the Order of the First Class of the Sacred Treasure of Japan. In December of the year 1877, he was elected foreign associate by the Paris Academy of Sciences. He was also a foreign member of the Berlin Academy of Science.

The scientific achievements of this remarkable man are largely in the nature of inventions; in them mechanical complexity is noticeably absent, owing to remarkable grasp of the underlying theoretical principles. As has been mentioned above, he invented the reflecting galvanometer and the siphon recorder, neither of which, it is interesting to note, he wished to patent, desiring to give them to the world as a physician gives his discoveries. Others of his inventions are the compensated mariner's compass now generally in use, a tide gage, a tidal harmonic analyzer, and a tide predicter. He also simplified Sumner's method of determining the position of a ship at sea. A very well-known apparatus of the greatest usefulness devised by him is the deep-sea sounder. By its use soundings can be made in one hundred fathoms of water by a steamer traveling at a speed of sixteen knots. Its essential parts are a piano wire and a detachable weight.

His greatest work was done in the realm of electrical measurement, and there is practically no electrical quantity in existence for which he did not produce the necessary measuring device.

Lord Kelvin's written works are in seven volumes, not including a "Treatise on Natural Philosophy," written in conjunction with Prof. P. C. Tait. Of these volumes, one consists of "Electrostatics and Magnetism," three of "Mathematical and Physical Papers," and three of "Popular Lectures and Addresses." His theoretical work is largely found in the monographs of the "Papers" for general physics, and in the "Electrostatics" for electricity.

Army Dirigible Airships.

We are gratified to note that Brigadier-General James Allen, chief signal officer of the United States Army, has issued specifications for the construction and supply of dirigible balloons for use of the army.

It is the expectation, after experiments with this class of air vessels have proven their utility and value for signaling and other purposes, that the War Department will issue other specifications for the construction of aeroplanes and other heavier-than-air machines, capable of traveling through the air at a greater speed.

The balloon specifications will be found in detail in the current Supplement. Briefly, they provide for a gas bag not more than 120 feet in length, made of aluminium-coated silk, and containing two ballonettes, suitable valves, rip cord, etc., and a suspended body framework that can be easily taken apart. The balloon must be able to carry two men weighing 175 pounds each, plus 100 pounds of ballast. Suitable power must be installed to maintain a speed of twenty miles an hour in still air. The balloons are to be delivered at Fort Meyer, Va., where the trial tests are to be made. Applications should be sent to the Signal Office of the U. S. A., Washington, D. C., prior to January 15, 1908.

Scale drawings of the proposed airship and a description of the engine to be used, as well as a certified check for 15 per cent of the price asked, must be submitted by every bidder.

Living Fish on Board Ocean Steamers.

An interesting departure has been recently made on the "Amerika" of the Hamburg-American Line by taking on board a special tank for keeping about a ton of living river fish for table use.

It was an interesting question whether or not the fish would stand the fatigue of the sea voyage. A large tank of 5.85 cubic yards capacity (14.76 feet in length, 3.28 in width, and 3.28 in height) had been constructed on the boat deck of the steamer. This tank, which is of iron, and divided into two compartments, was protected against the escape of the water in case of heavy oscillations by roofing, as well as by perforated sheet-metal partitions similar to bulkheads The two main compartments of the tank are intended, one for housing trout, and the other for larger fish.

As this experiment has been entirely successful, ocean steamers will in future be able to carry fresh fish instead of the fish preserved on ice, as much as two tons being readily stored in tanks of the kind described.

THE MANUFACTURE OF HIGH EXPLOSIVES.

BY THE ENGLISH CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

For the discovery of dynamite and other cognate powerful explosives, which have now become inseparable handmaids of the mining and engineering industries, the world owes a debt of gratitude to the late Alfred Nobel, the famous Swedish scientist and chemist, since he was the first to turn to practical purposes at his laboratory at Heleneborg, near Stockholm, the powerful blasting agent nitro-glycerine, discovered by Sobriero, and colloquially known as "blasting oil." This compound, owing to its extremely dangerous nature and the frequency of the accidents attending its use, was prohibited in many of the leading countries; and Nobel realizing these numerous disadvantages, concerted his energies for a considerable time in the quest for an agent with which the nitro-glycerine could be combined, and which while not deteriorating in the slightest its high explosive qualities, would at the same time enable it to be handled with comparative impunity. In this search he was ultimately successful by mixing the nitro-glycerine with an absorbent earth called "kieselguhr," and producing the compound now known as dynamite. The result of this discovery was an immediate expansion in the employment of the explosive for blasting purposes in all parts of the world. After establishing factories in Germany and France in 1871, Nobel went to Great Britain, where he established his future home, and also founded what is now one of the greatest and most flourishing British industries and the largest explosive works in the world.

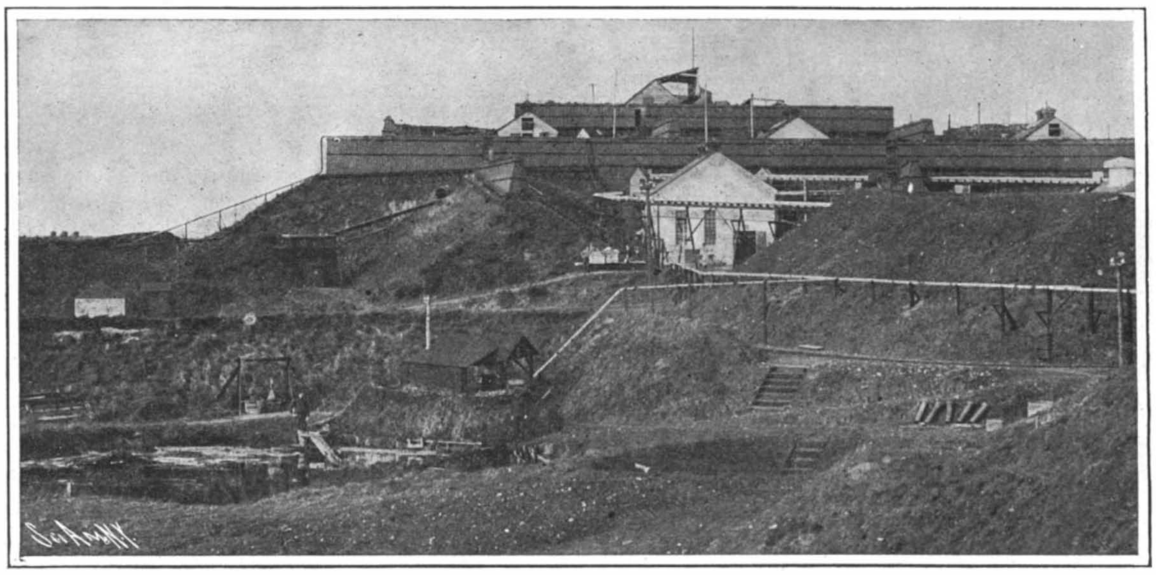
Nobel himself selected the site for his proposed factory, and his ultimate choice fell upon Ardeer on the west coast of Scotland. A more suitable spot for the prosecution of a dangerous trade could scarcely have been found, as the natural configuration of the country is a series of waste sand dunes, which lend themselves admirably to the work in hand by serving as natural barriers between the various sections of the danger zone. The factory covers an area of over 800 acres, occupied by more than 800 different buildings. The works are entirely self-contained, and thus a number of different subsidiary industries are embraced in the isolated colony established at a barren spot on the shores of the Atlantic.

Nitro-glycerine, as is well known, is a combination of glycerine and a mixture of sulphuric and nitric acids. The former is brought from all parts of the world, and upon arrival is subjected to a rectifying process, by which the various impurities suspended in the fluid are removed. The nitric acid is prepared in large buildings, in which are ranged long rows of retorts bricked up like ovens. These retorts are charged with sulphuric acid and nitrate of soda, and immediately the two compounds come into contact a chemical action commences, the nitric acid being released as a corrosive gas. The latter is carried through pipes on to a series of earthenware jars and other condensing apparatus, into which the gas is discharged and condensed. The nitric acid thus obtained is further mixed with sulphuric acid, also produced in extensive works on the spot, and conveyed in steel cars hauled by ponies to a station at the foot of one of the nitro-glycerine "hills," as the mounds in which this powerful explosive liquid is prepared are called. There are five of these "hills," comprising lofty earth embankments, within which are located the buildings in which the manufacture is carried out. The provision of the surrounding mounds covered with tall rank grass serves to arrest the flight of fragments of the structure within, and the concussion produced by an explosion should the building within from any cause "blow up." The hills are pierced in all directions with tunnels, by which means communication with the secluded buildings is maintained. When the cars filled with acids reach the foot of one of the hills, they are thence transported to the top by cable haulage.

In the "danger area" the severest discipline is maintained. All entrances are carefully guarded by searchers, who rigorously examine every individual that desires to enter, relieving him of any metallic objects that may be carried upon his person, together with matches and other suspicious objects, which upon coming into contact with the dangerous chemicals used in this zone might provoke serious trouble. No matter how often an employee engaged within the hill may pass in and out, every time he enters he must submit to this preliminary and essential operation. There are also some 500 girls employed, and these are under the charge of matrons. Hair pins, ordinary pins, shoe buttons, metal pegs within the soles of the shoes, knitting and other needles are all religiously barred. Their hair is tied with braid or ribbon, and as with the male employees, every time they enter the danger area they are similarly searched by the matrons.

Within the danger area the various employees engaged in the different departments or phases of work are garbed in special non-inflammable working suits, varying in color according to their respective occupations. Each operator is strictly forbidden to venture

beyond the confines of his own department except by special order, and any disobedience of this regulation can be immediately descried by the distinctive dress by one of the many superintendents at any distance. The type of dress adopted has mainly the object of preserving the workers from burns by powder taking fire, as wool is not readily ignited, and to prevent the introduction of foreign matters, as they have no pockets.



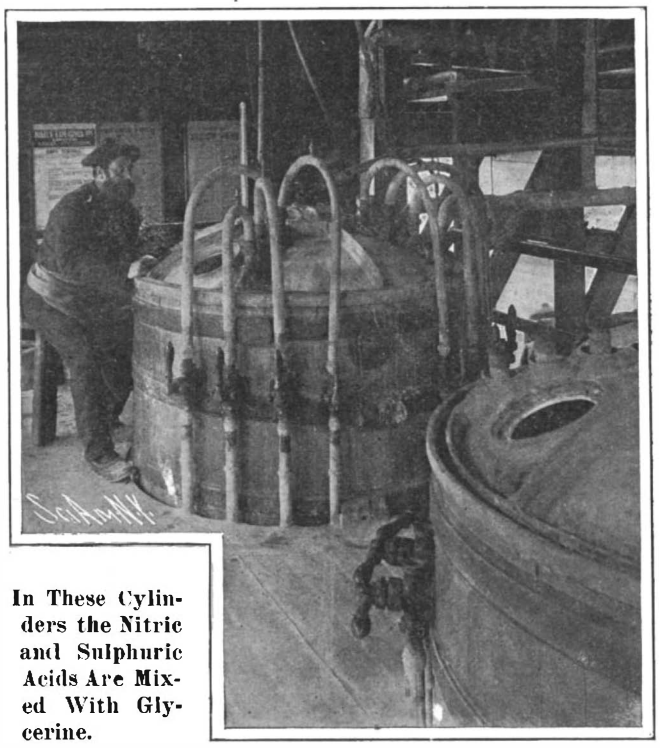
A Nitro-glycerine Hill.

A nitro-glycerine hill is approximately 60 feet in height. It screens in recesses several frail structures built of wood painted white and roofed with flaring red canvas. These are the nitrating and washing houses, and they are so arranged that the nitro-glycerine, after each progressive stage, can run by gravitation to the succeeding operation. The floor is covered with sheet lead, and the feet of all who enter the building are incased in heavy thick overshoes of rubber, since no shoe that has trodden the ground outside is permitted to touch the floor in a danger building, as thereby grit might be introduced, the subsequent friction of which might produce a spark, and fire the explosive contents of the building.

In each of the nitrating houses are two huge cylindrical leaden tanks with dome-shaped tops, five feet in diameter by six feet in depth. Beside the vat is seated the operative, with his eye glued to a thermometer extending into the interior of the cylinder. This thermometer is five feet in length, and only the upper part is visible, that containing the mercury bulb extending down into the chemical contents. The vat is charged with sulphuric acid mixed with nitric acid. The glycerine is admitted in the form of a fine spray, the jet being maintained by compressed air. The vat is entirely incased by a jacket, through which currents of ice-cold water are continually rushing, while similarly within the vat are four concentric coils of lead pipes, through which cold water circulates. The full charge within the cylinder of the nitric and sulphuric acids has to be supplied with 900 pounds of glycerine, and this operation is one of the most critical during the whole process of manufacture, being attended by the ever-present danger of spontaneous explosion. The chemical combination of the glycerine with the acids results in the generation of intense heat, the glycerine as rapidly as it enters the chamber seizing the nitric acid, thereby combining to form nitro-glycerine, while the sulphuric acid instantly absorbs the water which is released. It will thus be seen that it is imperative that the heat generated should be maintained within certain limits. The maximum allowed is 22 deg. C. (72 deg. F.).

Should too much glycerine, however, be fed in, the heat is liable to rise above the danger point, which fact is immediately revealed to the operator by the thermometer. The inflow of glycerine is instantly reduced or cut off, and a greater supply of air admitted within the vat. By such means, however, it is not always possible to arrest the action, and therefore, should the thermometer continue to rise slowly, the man gives a warning shout to his comrade below to "stand by." Should the heat still increase, he cries, "Let her go." The man below immediately opens a valve in the base of the cylinder, and the whole charge is swept quickly away, and the coming explosion killed in an excess of water in a special drowning tank. It is, however, not always possible to give warning of the impending danger. The heat may rise very rapidly and resist control, in which event the operator without any preliminary notice to his comrade simply shouts a warning to pull open the valve and runs to a place of safety, while the charge is instantly swept into the drowning tank.

The process of combination occupies about one hour, and at the end of this time the 900 pounds of glycerine has been converted to more than double the weight of nitro-glycerine. The compound now flows downward to the next compartment, where it has to be separated from the spent acids. It runs down a leaden gutter into a tank about eight feet in length by two feet in width, and when the tank is fully charged, the contents are allowed to stand for a little while. The nitro-glycerine being lighter than the acid rises to the surface like oil on water, and is then skimmed off by means of a large aluminium ladle and poured into a pocket at one end of the tank, whence it flows away through a pipe to the washing tank. It is first washed with cold and afterward with warm water and carbonate of soda.

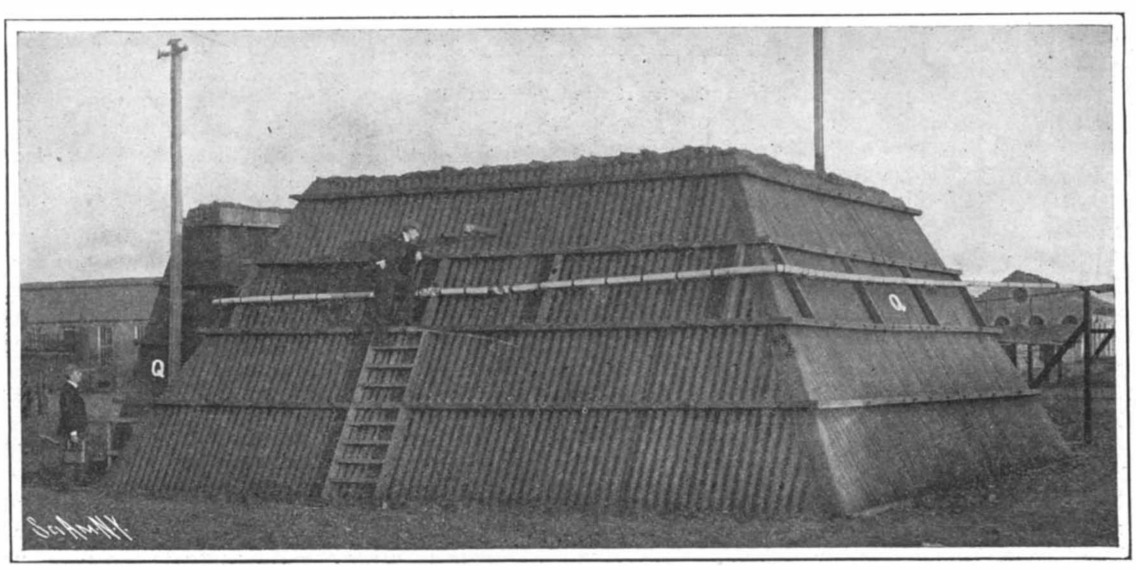


In These Cylinders the Nitric and Sulphuric Acids Are Mixed With Glycerine.

In a final washing house the nitro-glycerine is freed from every trace of acid—an imperative proceeding, since the slightest trace of this agent might at some time or another set up chemical action and heat culminating in an unexpected explosion. A sample of each charge of nitro-glycerine made is taken, in order to detect the presence or otherwise of acid by litmus paper and other tests. If satisfactory the product is ready for further operations, but if still containing traces of acid, further washing is necessary.

After leaving the washing departments the nitro-glycerine has finally reached the bottom of the hill, where it is made into dynamite. This apartment, like its fellows, is built of thin wood and the floor covered with lead. On either side is a low table, with the mixing box in which the kieselguhr is combined with the liquid nitro-glycerine. This absorbent earth is mainly composed of the skeletons of mosses and microscopic diatoms found in the black slaty peat of Scotland, Germany, Italy, and other countries. Upon its arrival at the factory it is first calcined in a guhr kiln, rolled, and sifted into the consistency of flour and is of a light pink color. The dynamite is composed in the approximate proportions: nitro-glycerine 75 pounds, guhr 25 pounds, and some carbonate of ammonia. The nitro-glycerine is poured into a small square wooden box about 3 feet square by 18 inches deep, containing the other ingredients, given a preliminary mix so that the liquid may be entirely absorbed, and conveyed to the mixing department by a runner.

The mixing operation is carried out by women, who knead and mix the ingredients together with their hands as if it were dough, the operation being carried out with complete thoroughness. The mixture is then picked up by a big wooden scoop and dumped into a sieve with brass meshes. The dynamite is rubbed through the orifices in small particles. As it passes through the sieve it resembles a greasy coffee-colored earth, finely divided, and the combination of the constituent parts being completely accomplished, the product is ready for the manufacture of cartridges. This work is also carried out by female labor. The cartridge houses are long rows of single cabins about 10 feet in length, and the same in width. All the buildings for the various phases of the work are divided into small units accommodating from four to six persons. In the cartridge house the machines are attached to the two side walls. They comprise a conical hopper into which the dynamite is placed, and a small vertical brass rod or piston actuated by a lever resembling a pump handle. At the base of the hopper is a small brass tube in which the plunger slides. As the piston descends into the mass of dynamite contained in the hopper, it forces the requisite quantity through the brass tube at the bottom into the cartridge wrapper, which the girl has twisted round the tube and holds in one hand. When the charge, about three inches in length, has been inserted in the wrapper, the latter is removed, the top folded down, and the finished cartridge dropped through a slot in the wall, whence it falls into a special receiver placed outside. The operator replenishes the supply of dynamite within the hopper from a box of loose dynamite placed outside the hut through a similar slot by means of a wooden spoon. The process of filling the cartridges is carried out with great rapidity, the result of continued practice, while the plunger of the filler is lubricated by the nitro-glycerine itself. In another hut blasting gelatine cartridges are made, the process being somewhat different. This explosive is 50 per cent more powerful than ordinary dynamite. It is of the consistency of tough elastic paste, and comprises about 7 per cent of nitro-cotton to 93 per cent of nitro-glycerine. The material is forced through a sausage machine, and as it issues therefrom it is chopped into three-inch lengths by a wooden wedge upon an India-rubber covered table, and wrapped into cartridges with almost lightning speed. There are in all seventy of these cartridge huts. Owing to the fact that nitro-glycerine congeals at 43 deg. F. and freezes at 40 deg. F., it is necessary to maintain the atmosphere within the buildings at an even warm tem-



Reading the Thermometer of a Heating Magazine.

THE MANUFACTURE OF HIGH EXPLOSIVES.

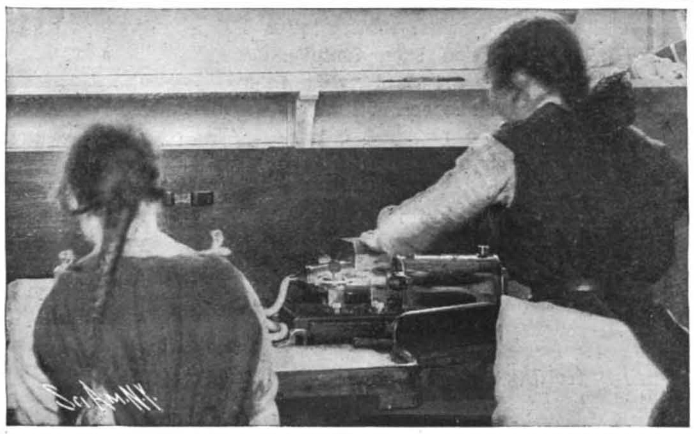
perature. Steam heating is employed, the minimum temperature being 50 deg. F., the radiating pipes being completely and carefully inclosed, so that no loose explosive may come into contact with the hot steam pipes, and possibly promote decomposition.

An extensive variety of explosives is prepared at these works, suitable for the various exigencies of commerce and war. The principal comprise various forms of gelatines and dynamite, such as guhr dynamite, blasting gelatine, gelatine dynamite, and gelignite, the latter two combinations of nitro-glycerine, nitro-cotton, nitrate of potash, and wood meal. The gelatine explosives are peculiarly adapted for submarine work, as they are entirely unaffected by wet or moisture of any kind. There are also produced the "Monobel powder" and "carbonite," which are specially designed for use in fiery coal mines, as they contain a lower proportion of nitro-glycerine than dynamite, and, in addition, cooling mixtures.

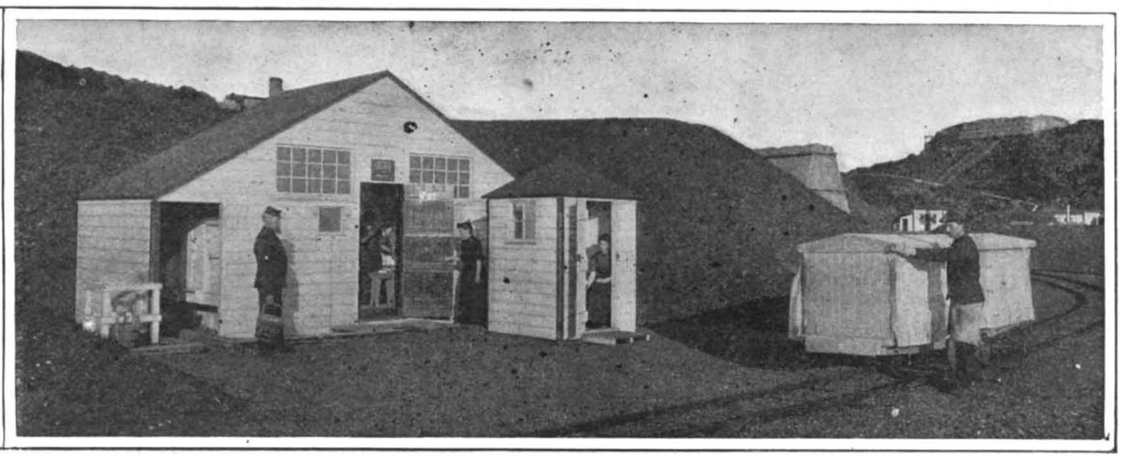
One of the greatest outputs of these works is guncotton in several varieties, either in its pure state or combined with nitro-glycerine, as "cordite" and "ballastite," or with blasting gelatine. The fundamental constituent is made from cotton waste, the material being the residue left on the spindles. The waste before use is shredded, cleaned to remove all dirt, grease, and other foreign substances, then carded and pulped, so that at last it is rendered a perfectly homogeneous substance. It is then ready for conversion into either insoluble guncotton or soluble nitro-cotton. The process of nitration is carried out in small iron pans in large, lofty, single-floored buildings. The pans are jacketed during the nitration by standing them in long iron coolers. Running along the coolers are the acid taps, whence the requisite supplies are obtained. Four pounds of cotton are placed in a pan with 115 pounds of mixed sulphuric and nitric acids. The chemical combination is completed in a few minutes, or may take several hours, depending upon the quality desired, and the acids are then poured off while the desired quality of nitro-cotton is ready for its first washing. Until the nitro-cotton has had every trace of the acid removed, the danger of spontaneous combustion is ever-present. It is no uncommon circumstance for the substance to flare up as the operator empties the contents of the centrifugal acid separator. No harm, however, results beyond the possible singeing of the eyebrows and the emission of a column of noxious smoke. The washing process is therefore most thorough in character. Not only are the contents whirled and tossed about in several changes of water, but they are boiled and then pulped in ordinary pulping mills, after which they are subjected to drying operations in rotary centrifugal machines until all but 40 per cent of the water has been extracted, the remaining quantity being eliminated in the drying house at a temperature ranging from 100 to 120 deg. F., the hot air currents being circulated by fans. Nitro-cotton forms the principal constituent of a large variety of explosives, the proportion varying according to the nature of the resultant explosive required. For blasting gelatine, 7 per cent soluble nitro-cellulose is used; for cordite, 37 per cent insoluble; ballastite has 60 per cent soluble with 40 per cent nitro-glycerine, etc. In connection with the preparation of the last-named product, use has been made of the curious chemical action that takes place, whereby it may be manufactured by the "wet process" invented at Ardeer, and which is extremely efficient, and what is far more important, much safer. No matter how much water is present in the tank in which it has been immersed, owing to the extraordinary affinity of the nitro-cotton for the nitro-glycerine, every particle of the cotton will find and receive its full saturation of the nitro-glycerine.

"Ballastite" is now a popular explosive for sporting and military purposes, being smokeless, clean in the gun, entirely unaffected by heat or dampness, and possessing great ballistic qualities. It is made in several forms, flakes, cubes, or tubes for cannon, and tiny flakes for rifles and sporting guns. When first made and dried it is an elastic paste of a light brown color, but in its final state it resembles thin elastic sheets of silky horn perfectly transparent. This metamorphosis is accomplished by passing the compound through steel rollers heated to 120 deg. F., which also renders it as thin as tissue paper. It can then be easily cut by machines into the various forms for which it is required.

Owing to the worldwide use that is made of the Ardeer products, great care is displayed on the part of the authorities in ascertaining the suitability of the explosive required for any climate. There are



Making Blasting Gelatine Cartridges.



A Dynamite Cartridge Hut.

Making Dynamite Cartridges.

Interior of a Mixing House.

Nitrating Room for Gelatines.

THE MANUFACTURE OF HIGH EXPLOSIVES.

two laboratory magazines corresponding to the extremes of temperature, the heat of the tropics and the intense cold of the Arctic. These two magazines are appropriately christened "India" and "Siberia" respectively. Of the two, the former is the more dangerous. Before entering the magazine the temperature of the interior is carefully noted through a peephole upon the large thermometer suspended within.

In view of the extreme and numerous precautions adopted at these works, accidents are of comparatively rare occurrence. At times, however, catastrophes, despite the measures observed, happen, but they are invariably of a comparatively small character. The rigorous regulations contained in the British Government's Explosives Act passed in 1875 conduce to the safety of the employees. The works are under the management of Mr. C. O. Lundholm, who has been associated for over thirty years with the Nobel works, and with the late Mr. Nobel himself, to whose courtesy we are indebted for the information contained in this article. Although the principal explosive works of the Nobel company are located at Ardeer, distributed over various parts of the country are cognate concerns associated with this Nobel industry, devoted to the manufacture of fuses, detonators, fulminate of mercury, and ammunition for all types of ordnance, so that the Nobel enterprise is in every respect one of the largest and most successful industries in Great Britain.

THE INFLUENCE OF PROFESSION ON THE SHAPE OF THE HAND.*

BY DR. ALFRED GRADENWITZ.

Though the human hand seems to be a fairly uniform structure, it really shows a differentiation as wide as that of the features of the face.

It is a well-known fact that the character of an individual can in a measure be read in his features, and a similar connection with haracter can be found in the form of the hand. The hand, however has a closer connection with actual occupation.

Whereas the influence of vocation on the traits (apart from a natural disposition for a certain craft that may lead to its adoption) is due mainly to a particular turn of mind connected with and produced by that vocation, the influence exerted on the shape of the hand is mainly of a physical nature. The continual repetition of the same kind of manual work results in a permanent alteration of the skin and muscles of the hand, as well as a transformation of the bones (atrophy or thickening of certain parts), displacement of the joints, etc., for in repeating a given manipulation over and over again, the palm and the balls of the thumb and little finger are called upon continually to perform the same action, leading to a permanent strain on and wear and tear of given parts of the hand.

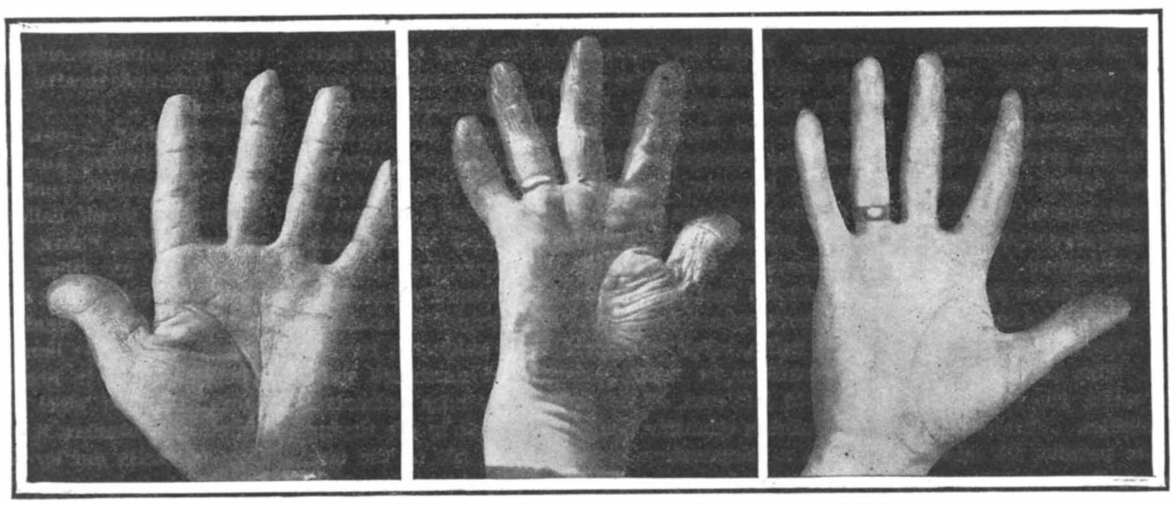


Fig. 1.—The Left Hand of a Smith. Fig. 2.—Right Hand of a Shoemaker. Fig. 3.—Right Hand of a Typesetter.

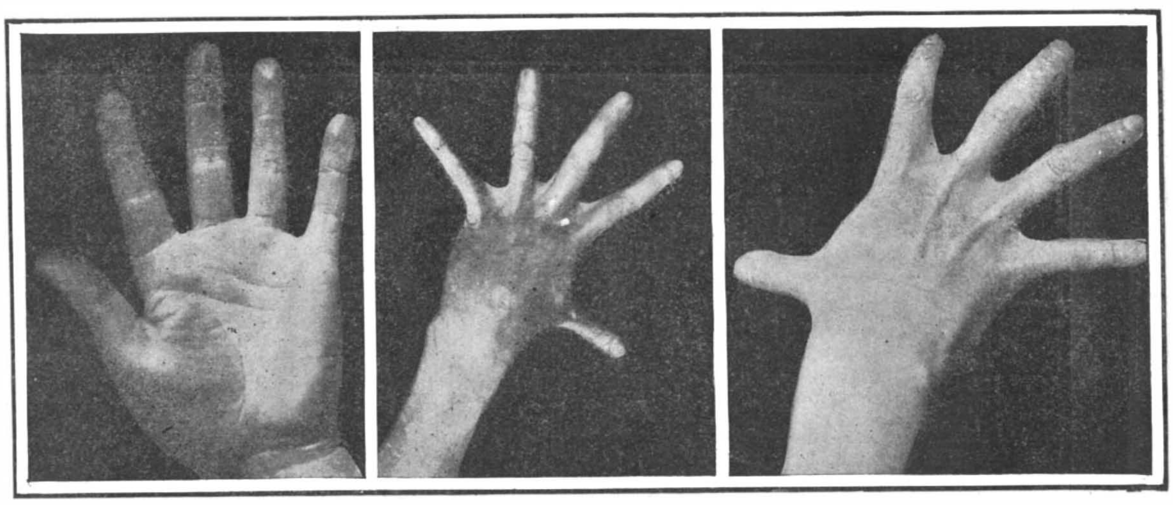


Fig. 4.—Left Hand of a Tailor. Fig. 5.—Left Hand of a Pianist. Fig. 6.—Right Hand of a Pianist.

THE INFLUENCE OF PROFESSION ON THE SHAPE OF THE HAND.

The most obvious alterations due to occupation are observed in the case of heavy manual laborers, who have coarse and clumsy hands with short, thick, and callous fingers, the balls of the thumb and the little finger being especially developed, and the skin being horny and covered with fissures. While these properties generally are especially striking in the right hand, it is sometimes even more interesting to study the left hand of individuals, as for instance in the case of a smith, who by continually using this hand to seize the heavy tongs, develops very marked balls and projecting broadened finger tips (Fig. 1). The thumb of his left hand in fact is used continually in pressing on the tongs, and so becomes especially strong. The right hand shows the marks of its continual use in handling the heavy hammer, while the fingers assume a shortened, clumsy shape. Similar facts, though to a less degree, are stated in the case of locksmiths.

A very striking sample of a deformed hand is represented in Fig. 2, which shows the hand of a shoemaker. This is characterized by the strikingly broad and flat thumb, while the fingers are likewise broadened and flattened at the top. This deformation is due to the continual pressure exerted in cutting the leather for the heels and soles, which operation calls for considerable strength, the fingers being set firmly against the surface of the hard leather, while the knife is kept in the fist. A continual pressure is furthermore brought to bear on the finger tips in working the heavy material, while the callous balls become strikingly thickened. The shape of the right-hand forefinger is also characteristic of the profession, the surface turned toward the thumb being flattened considerably, so as to give the finger a tapering form. This is due to the continual use of that part of the forefinger in seizing and fitting shoenails and tacks, resulting in a resorption of both the bone and flesh. The left thumb being used mainly to keep the object in position in nailing the leather, is not quite as broad and flat as the right-hand thumb. The striking deflection of the right thumb is well visible in Fig. 2.

Another type of hand, viz., that of a typesetter, is represented in Fig. 3. This is of a slender, regular shape, showing that the work done is not heavy. The actions connected with his profession are mainly performed by means of the thumb and forefinger of the right hand, the tips being used nearly exclusively in picking the type from the cases and inserting it in a narrow "stick" held in the left hand. This continual seizing by means of the thumb and forefinger tips is bound to result in an atrophy of the bones and tissues, which is especially marked in the surfaces turned toward each other. Both the thumb and the forefinger of the right hand accordingly show a tapering form in their upper parts, while the remaining fingers retain their normal broad tips. The left-hand thumb, owing to the permanent pressure exerted by the type box, is flattened and broadened at the tip.

The hand of a tailor, with smooth palm, likewise shows a striking difference from that characteristic of a man who does heavy work. The forefinger of the left hand of a tailor is especially characteristic, as the lateral surface turned toward the thumb shows a striking wear and tear at the tip, giving the finger a pointed shape. This phenomenon is due to the needle continually sliding over this part of the finger, which, as it were, serves as support to the needle, the thumb and forefinger holding the material.

After examining the hands of representatives of certain handicrafts, it will be interesting to study that of an artist. The hands represented in Figs. 5 and 6 are those of a pianist, which show some especially characteristic features. In fact, all of the ten fingers are remarkably flat at the tips on the side coming in contact with the keys of the instrument, as a consequence of the variable pressure permanently exerted on the latter. Furthermore, the fingers are strikingly long, as their members, in swiftly touching the keys of high and low notes, are loosened continually. On the other hand, the thumb and little finger, which spread out in opposite directions, are elongated to a considerable degree, and the other fingers, as well as the remainder of the hand, are likewise affected by this process.

While a study of the different types of hand is bound to appeal to the lover of psychology and sociology, it has been found recently to be a valuable aid to the criminal police in ascertaining the profession of a suspect. Like the various methods of determining the physical characteristics of an individual, which have been suggested in the course of recent years, an investigation of these factors may in fact give useful hints as to the identity of an individual.

* With six photographs by Carl F. Schroeder, Magdeburg.

DR. BRANLY'S APPARATUS FOR CONTROL OF DISTANT MECHANICAL EFFECTS.

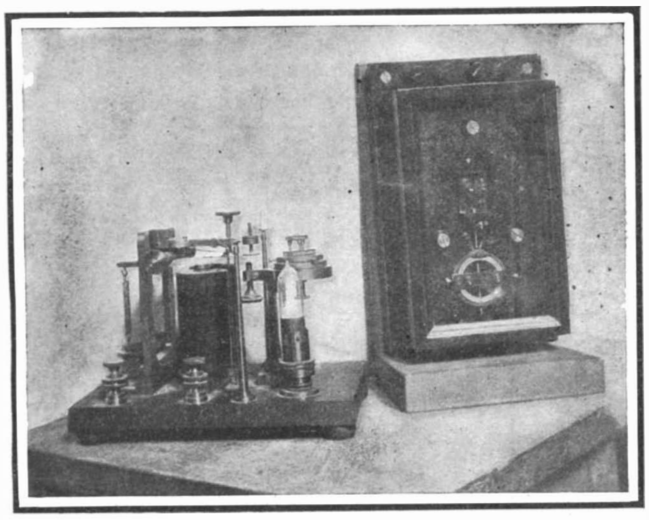
BY THE PARIS CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

Dr. Branly's latest apparatus, which allows of controlling different kinds of mechanical effects at a distance, has awakened great interest owing to the applications which it is likely to receive in practice. The apparatus enables an operator in a distant station to control by means of radio-telegraphy the lighting of lamps, explosions of mines, sending up rockets, mechanical movements such as the boring of metals, and any kind of action which is brought about by electro-magnets. Steering of torpedoes is one of the interesting uses of Prof. Branly's system, and other uses in military operations are at once apparent.

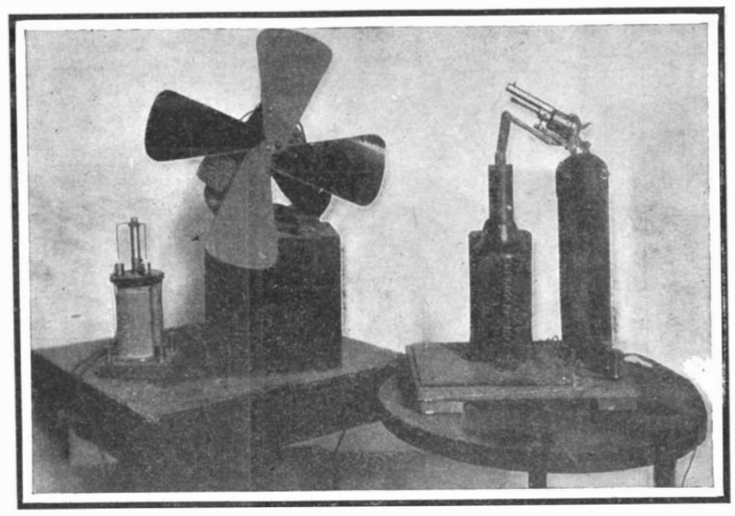
The principle of the system lies in the use of a series of distributing disks placed on a shaft which is driven by an electric motor. Suppose the operator wishes to light electric lamps at the distant point. In the lamp circuit is a relay which opens or closes it. This relay is worked from the circuit of a coherer and sensitive relay, so that when the operator sends a wave signal the coherer responds, closing the first circuit as in radio-telegraphy. This causes the lamp relay to operate and the lamps are lighted. What is now desired is to have the operator control a number of such apparatus at a distance. For this purpose each apparatus (supposing there are four of them such as he uses in his laboratory for demonstration, namely, a set of incandescent lamps, a revolver which is fired by an electro-magnet, an electric fan and an electro-magnet lifting a cannon ball) uses a separate disk placed on the shaft, with a fifth disk for controlling the motor. Each disk carries a projecting sector which makes contact with a brush during one-fifth of a revolution. During this period he can send sparks to operate this particular apparatus, and no other.

One of the principal features of the system is what Prof. Branly calls the "automatic telegraph." It serves to show the operator at the sending post the proper moment for sending the signals for controlling the different effects. These check signals are given him by a radio-telegram which is received upon a band of paper from a Morse receiver placed at the sending post. An apparatus placed at the receiving station sends these signals at the proper time by means of a spark coil connected so as to operate at certain periods by a special revolving disk. The latter is mounted upon the same shaft which carries the other disks. On the automatic telegraph disk are five groups of teeth, and each group gives an appropriate set of sparks so as to form a signal. A complete revolution of the disk thus sends five signals to the sending post to be recorded upon the paper, and these signals occur at equal intervals, or one-fifth revolution, corresponding to about four inches on the paper strip. On the upper band of this paper strip there are five signals, formed of from one to five dots. Suppose that there are four working disks on the shaft

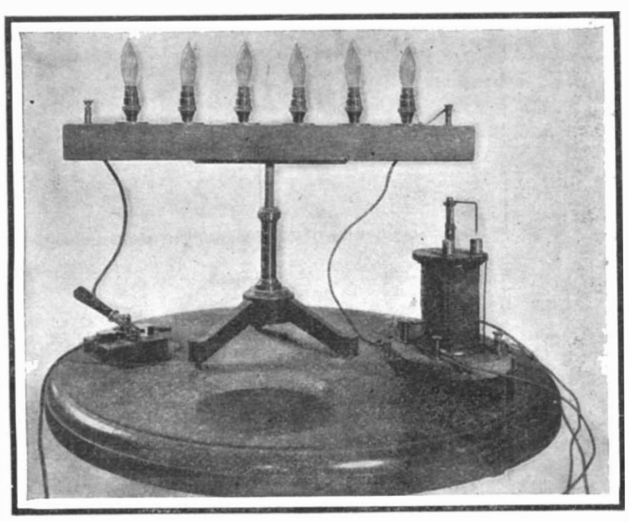
which respectively operate (1) the firing of a revolver, (2) the air fan, (3) lighting of lamps, (4) lifting of an iron ball. The contact projections on these disks are such that (1) is in contact during the period between the first and second signal on the strip, (2) between the second and third, and so on. By sending a spark while the paper is passing between the first and second signals he can control the working of circuit (1), and in the other intervals he operates the remaining circuits. Here the same coherer is used for all the different circuits at the receiving end, and it is inclose'd in a metal box screened by wire gauze so as to preserve it from the action of the automatic telegraph spark. At the sending station the coherer of the Morse receiver is also placed in a protecting box so as to protect it from the sparks of the coil. The same mast is used in turn for the different operations at the sending and receiving stations.



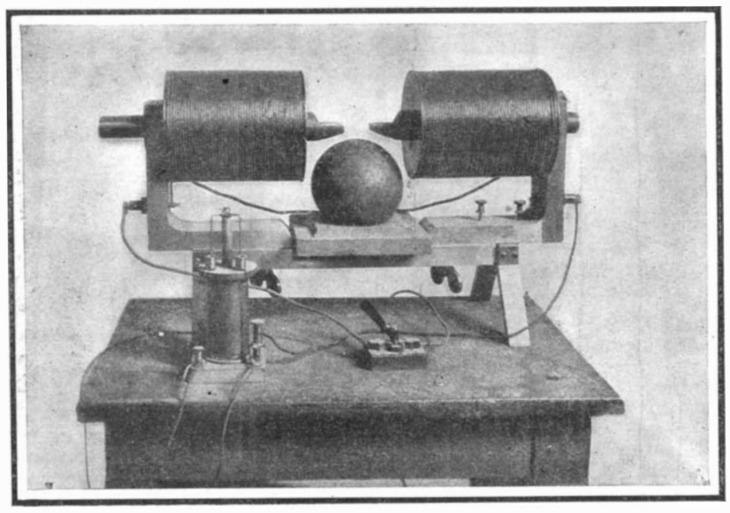
Coherer and Relay Used at the Receiving Stations.



Revolver and Electric Fan with Relay for Check System.



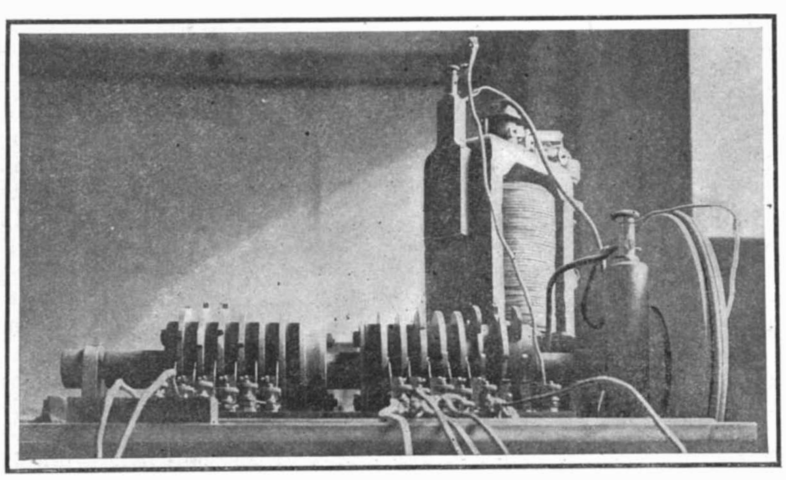
Group of Lamps Adapted to be Lighted by Dr. Branly's System.



Magnet and Ball with Check Relay Adapted to be Operated from a Distance.

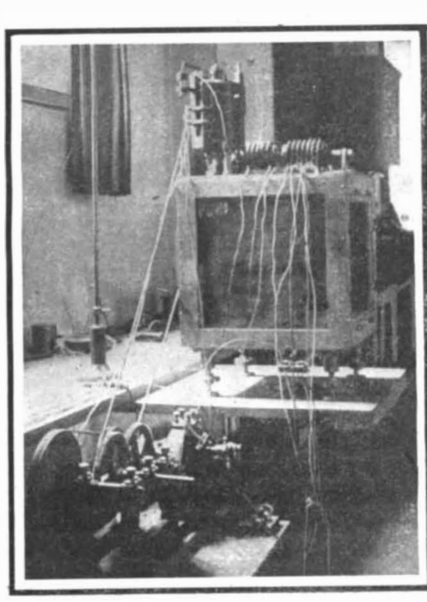
The electric motor which drives the shaft at the receiving station is also controlled by a relay and coherer in the same way as the other devices. It has a special disk on the shaft allotted to it, which makes its contact during the last period or between the fifth and first signals of the automatic telegraph. At this time the operator can start or stop the motor.

Another set of check signals is used which enables the operator to see whether the desired effect has been actually produced so that he can note accurately whether a certain mechanism which he set working is still continuing to run. The main shaft at the receiving station carries a separate set of disks which are used especially for this check system. Taking the case of the lamp lighting circuit, for instance, the disk belonging to it carries a projecting tooth which makes contact with a brush once in each revolution of the shaft, and can thus complete a circuit which includes the spark coil of the automatic telegraph. This action causes a signal to be sent to the operating station which is recorded on the paper strip. Placed in the lamp lighting circuit is a special relay which comes into action when the lamps are lighted. This relay keeps the above-mentioned check signal circuit prepared so that when the contact tooth comes around it will complete the circuit. But should the lamps have failed to light the relay would remain open and no signal could be sent. The operator would thus see that the circuit had failed to work. As regards the position of these signals on the paper strip, they are recorded just beside the regular signals of the automatic telegraph by means of a dash of a certain length which perforates the second signaling band. To check up the working of the apparatus at any time the operator first starts up the motor by a wave signal and then receives the series of dashes which the automatic telegraph sends him and which can be observed on the paper strip. He then stops the motor, and can repeat this operation at any time.

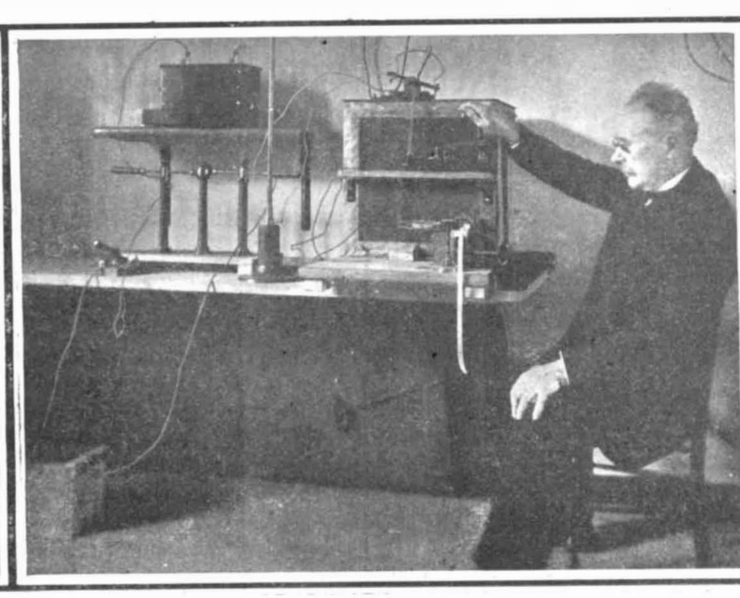


Enlarged View of the Disk Used at the Receiving Stations.

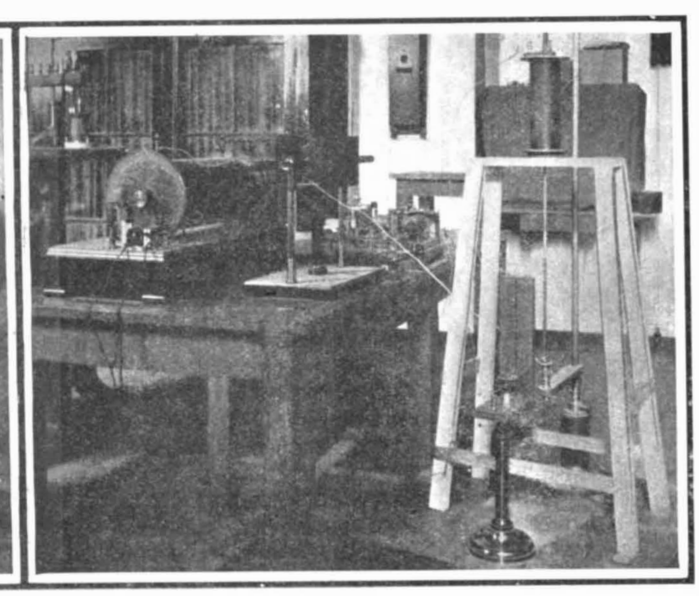
In operating a system of this kind, one of the essential points is to have it protected against the action of accidental sparks, atmospheric effects, etc., and Prof. Branly has found an effective means for doing this, outside the syntonizing of the apparatus, which at present is difficult to carry out. Naturally in the case of a continuous succession of sparks which are sent with the object of creating confusion it is impossible to work any radio-telegraphic apparatus, but the present method answers very well for accidental effects. A special interrupter is placed in the circuit of the receiving station. It consists of a wheel rotated by a motor, having a set of say five narrow contacts upon it, with two brushes placed side by side so as to close a circuit. The shaft carries a cam which the wheel can draw along with it in its rotation and the cam operates a closing key for the work circuit. A spark from the sending station causes the motor to turn by means of a coherer and relay, after which the circuit is opened by the wheel's revolution, since the first contact has now left the brushes. If at the moment the second contact touches the brushes a second spark is not sent, a lock bolt stops the wheel and motor and by a special electric device the cam which made one-fifth turn is suddenly brought back to the zero point. Should, however, a spark occur at the right moment the cam is allowed to go along with the wheel, and by sending the other sparks at each contact the cam makes a whole revolution and is now able to trip up the key and make



Receiving Apparatus, Showing Disks.



Dr. Branly at the Transmitting Station.



The Automatic Telegraph Apparatus.

DR. BRANLY'S APPARATUS FOR CONTROL OF DISTANT MECHANICAL EFFECTS.

contact for the work circuit. As it takes five properly-spaced sparks to operate the whole movement, it is seen that an accidental effect could hardly have any effect on the apparatus. In practice the operator sends a rapid succession of sparks in the period shown by the automatic telegraph, and these last for twenty seconds for each operation or for closing one work circuit. Thus he gives an action at each one of the five points mentioned above and the key is accordingly closed for that special circuit.

AN AUTOMATIC VIOLIN PLAYER.

BY GEORGE GILBERT.

In view of the present popularity of the piano player, and the marvelous perfection this instrument has attained in reproducing the work of the best musicians, it is very evident that it will be only a question of time before other musical instruments must similarly surrender to mechanical control. The latest development along this line is a machine which will play violins and kindred instruments. As may well be imagined, the violin offers difficulties which are peculiar to itself, and we are not surprised to learn that the violin player illustrated herewith is the culmination of seven years of continuous labor and experiment.

The instrument requires no alteration in the violin itself, and any violin may be placed in the player and removed without injury. The parts are pneumatically controlled in a manner similar to that of the ordinary piano player. A perforated music sheet selects the notes which are to be sounded. This sheet travels over a "tracker board," provided with the usual ducts in which an exhaust is maintained. There are two ducts for each note, and as these are uncovered by perforations in the music sheet, the air rushing into one of the ducts acts through the medium of the usual valves and pneumatics to press a finger down on one of the violin strings at the proper point on the finger board, while the air in the other duct puts into operation the bowing mechanism of this string. The bowing is done by means of four crystal disks, one for each string. In the accompanying drawing the details of the bowing mechanism are shown. Fig. 1 illustrates a section taken through the body of the violin *A*. The strings are indicated at *B*. The disks *C*, with which the bowing is done, are an inch in diameter and ⅛ of an inch in thickness. They are mounted in the ends of levers *D*, which are connected to the pneumatics *E*. When one of the bow ducts is uncovered, it operates a valve, which connects its respective pneumatic *E* with the exhaust chamber of the machine. The pneumatic is thus deflated, swinging the lever *D* to which it is connected, and bringing the disk *C* on this lever into contact with the selected string *B*. The disk *C* is rotated at high speed by means of a belt, which is guided along the lever *D*, as best shown in Fig. 2, and runs over a pulley *F* at the opposite end of the lever. When the lever *D* is swung into operative position by the pneumatic *E*, the pulley *F* is brought into contact with a driving pulley *G*, and is set in motion by a frictional contact therewith. This motion is communicated to the disk *C*, which operates on the violin string. The speed of revolution may run up as high as 2,000 revolutions per minute. The rate at which the disks revolve determines the loudness of the tones. A device is provided for applying rosin to the disks. This consists of a small cup attached to a spring arm and containing rosin, which bears against the revolving disks.

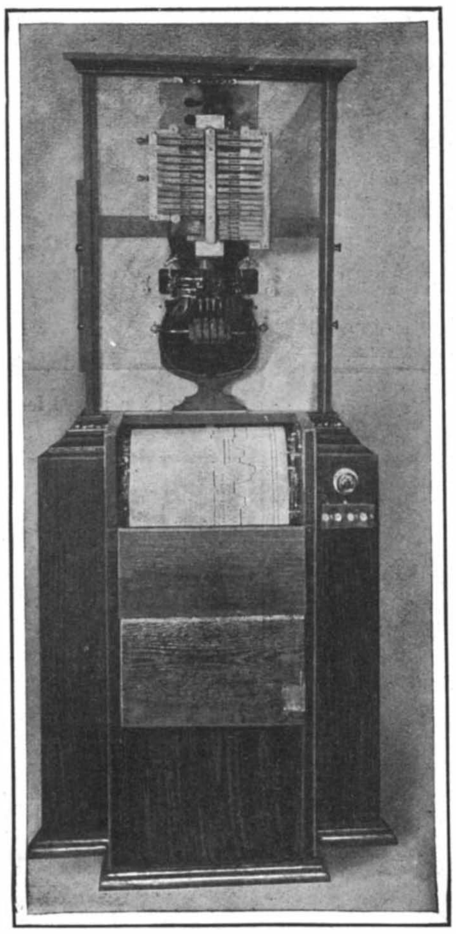
The fingers of the violin player are sixty-five in number, although more can be added if desired, to reach the extreme high range of the *A* and *E* strings. There is a finger for each note. The model shown employs fingers reaching the seventh position. In front of each string is stretched a rubber band, upon which the ends of the fingers strike, thus producing a touch like that of the human finger, and making it possible to imitate the "slide." The tremolo is produced by a set of four hammers, which are actuated by electric vibrators of the type used in call bells. When a hammer vibrates against a string, next to the bridge, the tremolo effect is produced on that string. All the strings may have this effect, or one, as the character of the music demands.

Directly over the violin are four small pitch pipes, which are blown, on pressing a button, by causing air to pass through the pipes, each of which gives the tone of one of the strings, *G*, *D*, *A*, or *E*. The operator then tunes the violin in unison with the pitch pipes.

Violinists know that it is hard to keep a violin in tune. But few appreciate that this is due to the sweat of the player's fingers, which makes the strings stretch. Strings on instruments placed in the violin player do not need much tuning. Silk *E* strings have been found to last two months, and have stayed in tune two weeks without attention.

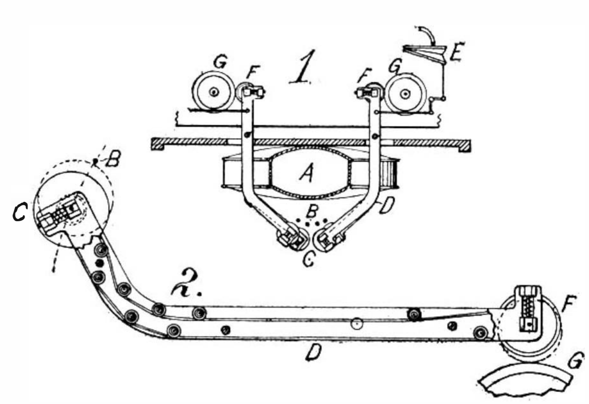
The tempo is varied by means of a friction pinion which is moved radially on the face of a large driving wheel. This device for varying the tempo enables the simulation of rubato passages when it is operated by a skilled musician.

Instruments of the violin family have four strings, each with a range of two octaves. The violin player enables each string to be treated, at will, as a separate violin, as each bow is controlled by a separate mechanism. In the model shown, the higher portions of the *G* and *D* strings are not utilized, but they can be by



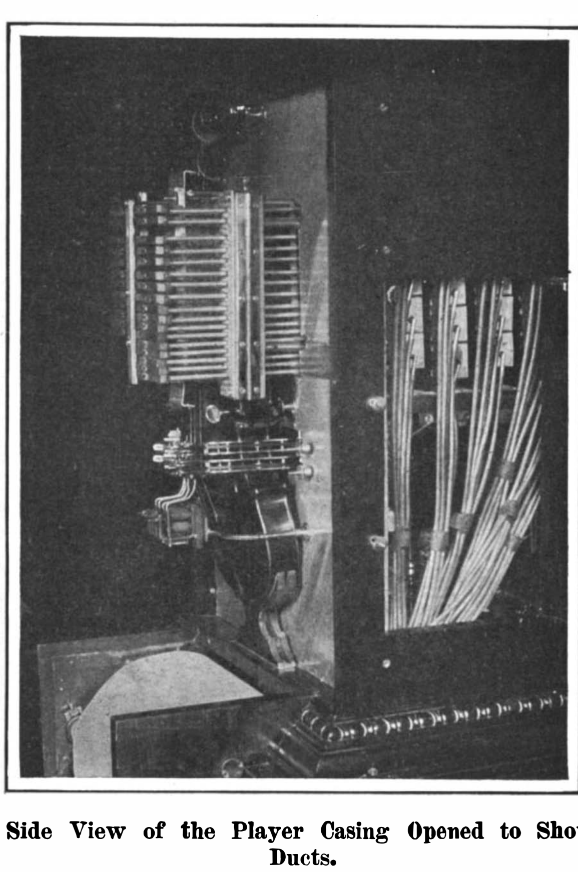
Front View of the Automatic Violin Player.

supplying extra fingers. Notes on a violin are found sometimes on each of the four strings. For instance, the *G* above the treble staff may be struck on all the strings; so that if a trill were being performed on that note on one string, an arpeggio passage containing the



Details of the Bowing Mechanism.

same note could be produced on the other strings. Of course, no human player could do that. It is possible for the player to render a solo part, with a cello accompaniment on the bass strings, or a solo with two accompanying violin parts, all on one violin. The possibilities for combinations of orchestral effect, therefore, are seen to be many.



Side View of the Player Casing Opened to Show Ducts.

AN AUTOMATIC VIOLIN PLAYER.

Harmonics are produced by the application of just enough pressure to a finger to make it rest lightly in the string sounded, thus imitating the action of the human finger. Trills are produced with striking clearness by providing a series of small perforations in the music roll. The same principle applied to the bow pneumatics produces springing bow and flying staccato.

In making the first music rolls for the player, the inventor, Prof. Wauters, of Binghamton, N. Y., had many technical details to solve. Instruments having fixed strings or tones are played on the tempered scale. But violins play on the untempered chromatic scale, and therefore it was necessary for Prof. Wauters to lay the groundwork for producing music rolls for instruments of that character.

Aeronautical Notes.

On December 18, M. Louis Bleriot attempted several flights with his latest Langley-type aeroplane on the parade ground at Issy les Molineaux, near Paris. This new machine is of the following-plane type, the rear planes being only about half the length of the front ones, and the machine being fitted with a 50-horse-power, 8-cylinder engine. On the afternoon of December 18, M. Bleriot made one flight of about 150 meters successfully, although his machine showed signs of imperfect stability. During his second attempt, after he had flown about 100 meters and while he was still in the air, both the forward wings snapped suddenly where they joined the body of the machine, causing it to fall suddenly and strike the ground with great force, after which it swung around and turned over. By the greatest good fortune M. Bleriot was not seriously injured. In view of the fact that he made many successful flights with his former machine (which was of the true Langley type) it would seem that the modification which he has made in the way of shortening the rear planes has not improved the stability of this type of machine. The fact that the planes snapped under the air pressure when going about 30 miles an hour, shows that M. Bleriot had not allowed a sufficient factor of safety in designing and constructing his machine. That he was not killed as the result of this accident was only due to the greatest good luck. It is to be hoped that other aviators will profit from his experience and will make sure that their machines are sufficiently staunch before trying to fly.

Further information regarding the loss of the French airship "La Patrie" shows that the manner in which this occurred was as follows: On the afternoon of Friday, November 29, shortly after the airship had ascended from Verdun with seven men on board, for the purpose of reconnoitering, the mechanic's clothing became entangled in the gearing and a temporary descent was made at Souhemes. When the accident first occurred, it was supposed that the trouble resulting therefrom could be quickly remedied, and the airship was allowed to drift before the wind while the mechanic was making repairs. The accident occurred about 2 P. M., and as the repairs had not been effected at dusk, a descent was made for the purpose of completing them. It required all the following day (Saturday) to complete the repairs and make all the necessary adjustments. The last of the workmen quitted the airship only a quarter of an hour before it broke away. This happened at about 8 P. M., when the wind increased greatly and blew a gale. The 180 men who were holding the airship down were not effective as ballast because their combined weight, although great enough to keep the vessel from breaking away, was not applied at one time, since the airship was whipping back and forth owing to the fury of the wind. Lieut. Lenoir risked his life in an effort to grasp the rip cord and deflate the envelope just before it broke away. Unfortunately he was unsuccessful and an extra heavy gust of wind tore the huge gas bag out of the soldiers' grasp and carried it quickly aloft. The loss of this airship will be felt not only by France (which nation expended fully $150,000 in constructing and perfecting it), but by the entire aeronautical world, since it was quite the most complete and perfected airship of the flexible gas-bag type that has thus far been constructed. It is to be hoped that the speedy construction of the second French airship "La Republique" will be hastened in order that there shall be no break in the experiments with dirigibles of this type.

Horse owners are often compelled to tie their horses rather close in the stall, for fear of accident resulting by the animal's becoming entangled in a halter strap which is too long. A weighted hitching strap is now to be had, with which the animal may have a good deal of liberty without any danger of this trouble. It consists of a piece of pipe with means of securing it to the woodwork of the stall, and a roller at the top over which the strap passes. A long weight slides up and down inside the pipe, and the end of the hitching strap is secured to it. The weight takes up all slack, and the length of rope which it takes care of is sufficient to allow the animal considerably more freedom than if tied in the ordinary manner.

RECENTLY PATENTED INVENTIONS.

Pertaining to Apparel.

BUSTLE.—Emily H. Wright, Port Washington, N. Y. In this patent the invention relates to wearing apparel, and its object is to provide a new and improved bustle, which is simple, durable, and exceedingly light in construction, and arranged to maintain its shape under all conditions of legitimate use, and to insure a proper hanging of the wearer's skirt.

HAIR-PIN.—G. H. Spray, New York, N. Y. The object in this case is to provide a pin composed of two members, one slidably mounted within the other, and the members so constructed that when in one position in respect to each other, barbs or sharp projections are presented to prevent the withdrawal of the pin, while when the members are in the opposite position in relation to each other the barbs are concealed or shielded.

FASTENER.—D. W. Palmer, Hermon, Maine. An object of the invention is to provide a construction embodying a U-shaped wire member composed of a cross-piece connecting two side arms, the free ends of which are bent upon themselves and sharpened to form piercing prongs, and a sheet metal cross-bar embracing both the cross-piece and side arms and having projecting catches adapted to engage the pointed extremities of the prongs.

Electrical Devices.

TELEGRAPHONE SYSTEM.—G. Morin, Habana, Cuba. The more particular object of this inventor is to so connect the telegraphone with line wires as to enable the instrument to be easily controlled from a distance. It further relates to means whereby a person may leave a telegraphone in such condition that during his absence it will automatically receive a message intended for the person and will, under proper conditions, reproduce this message carefully.

Of Interest to Farmers.

CORN-THINNER.—C. S. Shank, Scott Depot, W. Va. This invention relates to improvements in devices particularly adapted for thinning out corn plants, the object being the provision of a device for this purpose, that will be simple in construction, and by means of which the plants will be easily drawn out of the ground.

BALE-TIE.—E. H. Vance, Colton, Texas. The purpose of the improvement is to produce a bale tie from a wire strand or rod by bending the same, and securing the tie by means which will permit the tie to be shortened, for binding the bale upon which it was placed when said bale has been further pressed for its consolidation and a consequent reduction in bulk and girth. Its preferred use is on bales of cotton.

ADJUSTABLE TONGUE.—J. P. Neste, Lake Mills, Iowa. The invention pertains to attachments adapted to be applied to threshing machines, separators, and machines of a similar character, and to be connected to a traction engine, and the object is to provide means whereby such machines may be turned in the desired direction in inconvenient places, and readily backed between grain stacks, and guided in narrow passage-ways.

Of General Interest.

WALL CONSTRUCTION.—E. W. Steele and A. C. Shuster, Edna, Cal. The object of this improvement is to provide a wall construction of brick, concrete blocks, or the like, bound in place by wire cables, to render the wall exceedingly strong and durable, and capable of withstanding the action of earthquakes or other forceful jars.

GRAVE CONSTRUCTION.—W. Livingston, Hastings, Neb. An object of this inventor is to provide a construction which can be applied to already completed graves, and which provides a top comprising a solid slab of cement or concrete. Another purpose is to provide a construction having a supporting arch with the crown substantially flush with the surface of the ground, and suitably supported on the arch a grave top consisting of a solid slab of cement, concrete or the like.

MATCH-BOX.—M. F. Luna, Santillo, Mexico. This match box is adapted to be carried in the pocket and conveniently operated when desired. It may be made of paste-board, wood, metal or other suitable material. Matches may be supplied to the holders when the latter are opened and the holders can be subsequently closed and applied to the casing. The outer side of the cases may receive advertisements.

MEAT-TAG.—R. H. Jackson, Rochester, N. Y. The object in this case is to furnish novel details of construction for a meat tag that is specially adapted for the use of meat and is not removable without cutting the same; and furthermore, that is not capable of re-use after it has been secured in meat that has been inspected.

DOG-MUZZLE.—W. H. Dusenbury, New York, N. Y. The purpose of the invention is to provide an economic form of muzzle, so that it will not chafe the nose at any point, and which will also effectively prevent the nose protruding through the front of the muzzle. It may be constructed almost entirely of wire, and worn with comparative ease.

STIRRUP.—J. Tweit, Ericson, Mont. The objects here are to provide a stirrup that may be manufactured and sold at a small cost, that will have a spring-yielding movement, thus relieving a horse to a considerable extent from the pressure of the rider, and from which a rider's foot may readily slide laterally of the foot plate in case of accident.

BOX-FASTENER.—L. B. Prahar, New York, N. Y. The purpose of the improvement is to provide a means whereby the latch sections of fasteners consist of but two parts, thereby not only materially reducing the cost of manufacture, but at the same time producing a stronger article, and one wherein there is little or no liability of the parts becoming separated and lost.

BRACKET.—L. Nolan, New York, N. Y. The inventor produces a type of bracket suitable for use in connection with supporting horses of the kind shown in a former patent granted to Mr. Nolan. The more particular object of the present invention is to produce a bracket suitable for supporting a straight edge at a convenient distance below the platform resting upon horses of the kind above mentioned in order to facilitate trimming of selvages or marginal edges from paper, cloth, or other similar material resting upon the platform.

CEILING CONSTRUCTION.—V. Moeslein, Weehawken, N. J. The object of the invention is to provide a ceiling construction for fireproof structures having metal laths supported by the cement or other concrete floor filling and forming a key for the reception and retention of the plaster, to permit of forming an exceedingly strong and durable ceiling, not liable to fall, and having a smooth, uniform surface.

NON-REFILLABLE BOTTLE.—H. C. Johnson and O. Steidel, Washington, D. C. The object in this instance is to provide a novel construction whereby two balls within the neck of the bottle may operate one as a sealing ball and the other as a stop ball in connection with a novel construction of bottle neck for permitting the contents of the bottle to be poured or dispensed and for preventing the refilling of the bottle.

HYDROCARBON-BURNER FOR FURNACES.—B. L. Worthen, Tucson, Ariz. Ter. In the use of a plurality of hydrocarbon burners within the walls of the smelting chamber, for the purpose of projecting oxidizing desulfurizing flames into or against the mass of ore within the chamber it frequently happens that the smelting is seriously interfered with. This is due to the collapse of one or more burners, which causes reduction of working pressure within the chamber with evil results. The present burner overcomes these and other disadvantages.

APPARATUS FOR ASCERTAINING THE PROBABILITY OF FROST.—L. H. Bernel, Paris, France. Hitherto, apparatus such as the August's psychrometer composed of two thermometers, the one dry and the other wet, could be used for that purpose, but after having read the figures it was necessary to refer to tables in order to detect the dew-point and to ascertain whether there was any danger of frost. This reading cannot be effected by everybody, and the present device avoids the disadvantage.

BAG AND FASTENING.—T. L. Beam, Lake City, Col. The bag is especially adapted for the purpose of carrying specimens of ores or similar articles. It may also be used to carry wheat, oats, potatoes, cement, coal, etc. The inventor's object is to construct it in such a way as to facilitate the removal of the contents, while at the same time provision is made for preventing the loss of any of the contents of the bag, which might otherwise occur through an imperfect closure at the mouth of the bag. The bag admits of sealing.

ATOMIZER.—W. J. English, Cohoes, N. Y. This invention pertains to an atomizer adapted particularly for use as a laundry spray; also it may be used for spraying other articles. The operator needs to simply blow through a horizontal tube, or the bulb may be secured to the outer end of the above tube whereby on pressing the bulb the necessary spray will be obtained.

Hardware.

CLAMP.—M. A. Reare, Los Angeles, Cal. This invention is an improvement in clamps, more especially designed for clamping two strips of material together in obtaining dimensions. The invention will be found especially useful in measuring rooms as in making measurements for picture-molding, base-boards, etc., and in numerous other relations.

WIRE-STRETCHER.—D. C. Pullins, Conway, Ky. The stretcher is adapted for use in constructing wire fences, either of ordinary strands of wire or of woven wire material, such as commonly used in fence construction. The drum in this stretcher may be forcibly operated to tighten the fence material, as desired, and the long and short hooks of the hook section will be found especially useful in stretching wire fabric.

SKINNING-TOOL.—J. C. Boyle, Calgary, Alberta, Canada. This invention has reference to butchering, and the aim is to provide a skinning tool, arranged to permit of quick and accurate skinning of animals without requiring a skilled or expert knife man, and without danger of cutting the flesh or mutilating the hide.

COMBINATION-TOOL.—P. A. Benet, Boston, Mass. The more particular purpose in this case is the production of a device provided with a number of related parts serving different purposes, the device being of especial value in reference to boxes and other receptacles used for packing and unpacking goods.

Heating and Lighting.

STEAM COOKING APPARATUS.—W. F. Lorentzen, Habana, Cuba. The invention pertains to apparatus for steaming or cooking by steam sugar cane juice, or any other liquids, seeds, and other products, an object being to provide an apparatus of very large heat-radiating surface which increases the heat to a much greater degree, with an economical use of steam, than is possible with the usual steam heater.

LIQUID-FUEL BURNER.—J. H. Koons, Anderson, Ind. The improvements are in burners for gas produced by the admixture of oil or denaturized alcohol, with low pressure air and high pressure air or steam, the object being the provision of a burner with which an intense heat may be obtained, and particularly adapted for use in connection with milling or blast furnaces.

Household Utilities.

DINING-TABLE.—J. A. Schackner, New York, N. Y. The object of the inventor is to provide a table having a rotatably mounted central section which may be freely moved in respect to the remaining portion, so as to avoid the necessity for passing dishes about the table, it only being necessary to place them upon the rotary section and turn the section until the dish comes within reach of the person desiring the same.

APPARATUS FOR CANNING AND WASHING.—H. D. Chance, Loveland, Col. The patentee has devised improvements that may be embodied in either machines for washing clothes or apparatus for use in canning fruits and vegetables. In connection with a vessel having means for heating coil which is to be subjected to the heat of furnace or burner, a perforated interior container is arranged and a perforated bottom; the object of the improvement being to cause effective circulation of the water.

CLOTHES-LINE BRACKET.—J. D. Schmidt, New York, N. Y. The device is adapted to be secured adjacent to house windows and serves to support clothes lines. The object of the invention is to provide a device so arranged that the house end of a line may be drawn through a window, permitting a person to place articles on the line without leaning out of the window; thus preventing the possible danger of a person falling.

Machines and Mechanical Devices.

THREAD-STRETCHING DEVICE FOR THE WARPS OF DRUM PRINTING-MACHINES.—F. Schmidt, 7 Edisonstrasse, Oberschöneweide, Germany. The method of operation is based upon the fact that owing to the braking action, a uniform loading of the roughened surfaced brake roller takes place, so that it always presents the same resistance to the thread drawn off. On drawing off the threads the above brake roller revolves and the threads have, while they are wound upon the upper surface of the roller, to overcome the uniform resistance thereof.

PUMP-LUBRICATOR.—H. L. McCullough, Cropsey, Ill. More especially the pump is designed for lubricating cylinders, valves, bearings and other parts of steam engines, air compressors, gas engines and other machinery, and arranged to permit minute regulation of the amount of the lubricant delivered, and to automatically relieve the pump of undue pressure incident to clogging up of the discharge passageways or the like, thus preventing injury to or stopping of the pump or waste of the lubricant.

LATHE-TOOL.—J. P. Aylesworth, Endeavor, Pa. One embodiment of the invention consists of a shank having an arm pivotally connected near the outer end thereof, the arm projecting slightly beyond the shank, where it is provided with an apertured enlargement for holding devices used in the centering operation. A suitable adjusting and a clamping screw are carried by the shank for adjusting the vertical height of the centering device and clamping the same in adjusted position.

CARRIER.—J. Hall, Fresno, Cal. The object of the invention is to provide a device adapted for the simultaneous conveyance of material such as grain, fruit, coal, raisins, etc., to different oppositely located points, and which is provided with a plurality of conveyers all having belts. The carrier is so constructed that if through accident one of the conveyers becomes blocked or otherwise inoperative, the material being distributed to the inoperative conveyer will be directed to an adjacent operative conveyer.

Prime Movers and Their Accessories.

ROTARY ENGINE.—T. C. Henry, Montgomery, La. The more particular object of the inventor is to provide a type of such engine employing a minimum number of parts, so as to reduce the loss from friction and vibration. By the arrangement employed the steam or other elastic medium is free to expand after entering the steam space, thus insuring economy in the use of steam or other elastic fluid.

Railways and Their Accessories.

CAR-ARRESTER.—W. Cook, Broadhead, Col. The invention refers to means for spragging or arresting cars while traversing a car track, and the object is to provide a construction that may be readily placed upon a car, and afford convenient reliable means for quickly arresting a car having the improvement, while it is in motion; and by manipulation of a lever at one side of the car body release the car for free movement on the track.

AUTOMATIC TRAIN-PIPE COUPLING.—R. M. Fyock and S. Stone, Butler, Pa. By the inventors' construction it is possible either when the cars are first coupled or at any other time, to contract the gasket firmly on the tubular portion to prevent leakage, thus always insuring proper coupling. The shaft of the hand wheel may extend out to the side of the car in a convenient position for manipulating the plug without necessitating entrance between the cars.

SMOKE-BOX OF LOCOMOTIVE-ENGINE AND SIMILAR BOILERS.—S. S. Younghusband, Granville Terrace, Woodlands-road, Darlington, England. The primary purpose of the invention is to prevent accumulation of ashes in the smoke-boxes of locomotive engine and similar boilers, a further object being to diminish the risk of the hot cinders ejected from the chimney setting fire to surrounding objects.

CONNECTING DEVICE FOR DISABLED RAILWAY-CARS.—R. P. Williams, Santa Barbara, Cal. One of the purposes of this inventor is to provide a very simple and readily available means whereby to couple cars disabled by breakage of the couplings, or even in the event the draft timbers and drawheads are pulled out of one car, which often takes place. The coupling is effected at any point in the length of the train, avoiding need of switching the disabled car or cars to the rear of the train.

Pertaining to Recreation.

AMUSEMENT APPARATUS.—H. E. Riehl, New York, N. Y. The invention relates to inclined pleasure railways such as are used in exhibition grounds, parks, pleasure resorts, and the like, and its object is to provide a new and improved amusement apparatus, arranged to provide an exciting and interesting ride for the passengers.

AMUSEMENT DEVICE.—W. J. Millican, New York, N. Y. This device embodies features of both a toboggan slide and an ordinary amusement wheel by which one is elevated a considerable distance above the surface of the ground as the wheel revolves. The car or like body will repeatedly travel through the hub of the wheel under the influence of gravity as the wheel revolves.

Pertaining to Vehicles.

AUTOMOBILE-CHAIR.—A. L. Moss, Sandusky, Ohio. The object of the invention is to provide a chair more especially adapted for use in automobiles and similar vehicles, and arranged to permit convenient adjustment of the chair in a longitudinal direction within the body of the vehicle, to suit the convenience of the occupant.

REACH-COUPLING FOR RUNNING-GEARS.—G. W. Loeffler, Tampa, Fla. In the present patent the invention refers to improvements in running gear for vehicles and more particularly to the reach coupling means. The object of the invention is to provide a simple, cheap, and efficient means of coupling the reach and running gear and is designed as an improvement on the gear shown in the patent formerly granted to Mr. Loeffler.

LOADING ATTACHMENT FOR WAGONS.—E. Lauppe, Antelope, Cal. The object of this invention is to provide a device that may be removably attached upon the rear end of a freight wagon, and afford means of utilizing horse power for loading bales of hay or other material on the wagon and thus dispense largely with manual labor for such a purpose.

VEHICLE RUNNING AND PROPELLING GEAR.—C. E. Phillips, Bremerton, Wash. The principal feature is an endless track composed of a series of feet or devices adapted for contact with the ground or other surface for supporting the vehicle, and also effecting propulsion, such feet or bearers being flexibly connected and traveling around elongated horizontal frames of approximately oval form, the frames being arranged in pairs in front and rear beneath the vehicle body.

Designs.

DESIGN FOR RIBBON.—E. M. Corbett, Paterson, N. J. In this design the band of ribbon is ornamented with rather widely scattered leaves and branches of mistletoe and small Teddie bears. Mr. Corbett is also the patentee of another design for ribbon in which the ornamental feature comprises a graceful serpentine line of connected mistletoe grasped at intervals by the one hand of Teddie bears.

Note.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Notes and Queries.

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

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(10644) W. G. H. writes: In a work upon electricity supposed to be reliable I find what is termed the "electromotive series" given exactly in the order of the following elements, namely: Zinc, cadmium, tin, lead, iron, nickel, bismuth, antimony, copper, silver, gold, platinum, graphite. The book says that the element which is acted upon by the electrolyte is always positive to the other. A writer in the SCIENTIFIC AMERICAN SUPPLEMENT gives a different explanation, and a variation in the order of the series. In the issue of July 13, 1907, A. Lang in an article upon galvanizing says: "The reverse of the order in which I have previously placed the metals in relation to their conductivities, i. e., antimony, zinc, lead, tin, iron, and copper, indicates the positive direction in which the current will flow from metals having the higher to those having the lower potential." Mr. Lang bases the order of the series upon the conductivities of the metals. A. The table of contact difference of potential used in the article by A. Lang, to which you refer in your inquiry, is based upon Ayrton and Perry's experiments, and is essentially the same as is given in Everett's "Units and Physical Constants," and the Smithsonian Physical Tables. We do not know any better authority, and should accept it as correct. The disagreement of authorities cannot always be explained. Usually, we may take a later authority in place of an earlier one. The difference between tin and lead is so little that one might easily be mistaken in assigning the places to these two.

(10645) E. S. A. asks: What modern methods are used for ventilating motor and generator armatures of various types? A. Modern electrical generators and motors are designed so that the rise in temperature shall not exceed a certain amount. No special mechanical provision is required to ventilate or cool the armatures, although a large number of inventions for this purpose have been made.

(10646) A. O. writes: A striking example of the effects of sound waves was noticed on September 15 at the morning session of the East Ohio Conference, held in the First Methodist Episcopal Church of Cleveland. During the singing of a hymn by the congregation, which numbered about twenty-five hundred, a large chandelier, weighing over a ton, was set in motion. It is hung by a chain about forty feet in length from the center of a large tower placed over the center of the church. No explanation can be given for the fact save that the walls of the tower so condensed and reflected the sound waves that they started the huge pendulum-like chandelier to swinging. A. Your observation is interesting. It is doubtless true that the chandelier was set swinging by the waves of sound. Church windows have many times been brcken by the same means. Some note occurs to which the chandelier chain can respond in sympathetic vibration. It must not be supposed that a force equal to a ton or more was exerted to swing the chandelier. A minute force applied many times, in time with the vibration period of the chandelier, set it to swinging.

(10647) R. B. writes: Correction to reply in Notes and Queries column, No. 10618, September 28, 1907, "Oxalate of Lime Process for Concrete Tanks." The use of hot paraffin wax to impregnate the concrete tank for gasoline storage would be impracticable, owing to the fact that paraffin is exceedngly soluble in gasoline and would therefore be promptly dissolved out of the concrete walls, causing excessive seepage of gasoline through the walls into the ground. A far more perfect gasoline-tight tank could be made by brushing over the walls with hydrochloric acid, sp. gr. 1.10, applying the acid freely, having it previously warmed to about 80 deg. C., allowing it to react on the calcium compounds in the concrete, and after an hour or so, go over the surfaces again with a strong hot solution of ammonium oxalate, brushing it freely and allowing it to react on the calcium chloride produced by the hydrochloric acid. This process fills the pores of the concrete with the insoluble compound calcium oxalate, which is insoluble in water or gasoline and entirely stable and permanent. After applying the oxalate solution, allow the walls to dry and then remove any soluble salts formed by the chemical reaction by washing down with water. The tank after drying again is ready for the reception of gasoline. The writer treated a tank in this manner for holding gasoline for laboratory purposes and finds it perfectly tight after a year's service. It is needless to say that the walls must be bone dry before applying the acid in order to get the best results.

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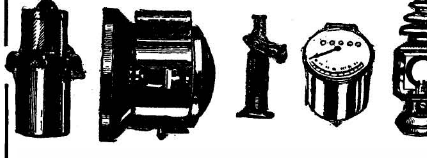

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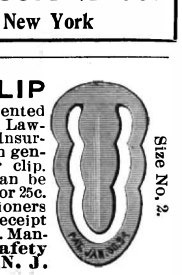

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